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NEW STEAMSHIP KROONLAND OF THE INTERNATIONAL NAVIGATION COMPANY.

The twin-screw steamship *Kroonland,* which is the latest addition to the fleet of the Red Star Line of the International Navigation Company, is in many respects a remarkable vessel. She is the fifth new ship built for the International Navigation Company within a year, and is the largest ship yet built in America.

RED STAR LINE STEAMSHIP KROONLAND.
(Copyright, 1902, International Navigation Co.)

In this vessel the Messrs. Cramp, from whose shipyard she was launched in February of this year, have established many records. The time elapsed from the date of the launch until the date of sailing on the first voyage was four months, which indicates the resources of this famous shipyard for rapid work.

The *Kroonland* presents several novel features in design, but the most noteworthy fact is this—that in her the builders have solved the difficulty of riveting a large ship throughout by machine tools. Experience with many recent ships of large size has shown that the best hand-driven riveting is insufficient to meet the demands made by the Atlantic service for closeness and soundness of work. The ships are now so large that the stresses brought upon them by Atlantic weather are very great, and nothing but machine riveting can develop the strength which is provided by the heavy material used in the structure. The problem presented to the Messrs. Cramp was how to adapt pneumatic power tools to deal with intricacies of shipwork. The impossibility of adapting hydraulic power tools to such work had long before been proven; and although many parts of a ship hitherto considered beyond the reach of hydraulic tools had been successfully riveted by improved hydraulic riveting tools, it was manifestly impossible to get such tools made suitable for application to all parts of a ship. The builders, therefore, turned to pnuematics, and by the aid of one of the prominent pneumatic-tool companies the required tools were produced and existing tools were adapted to work which, until then, had been considered beyond the scope

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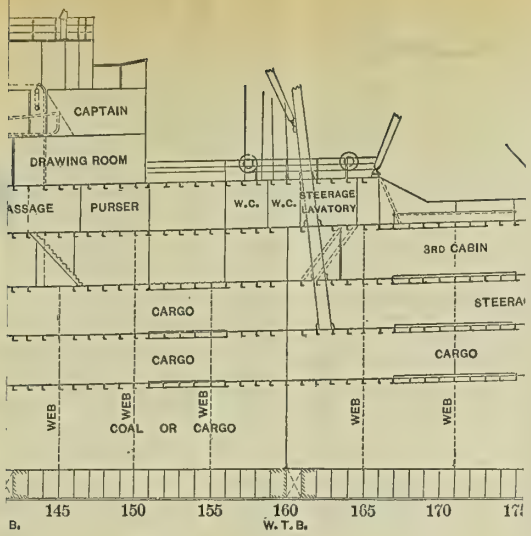

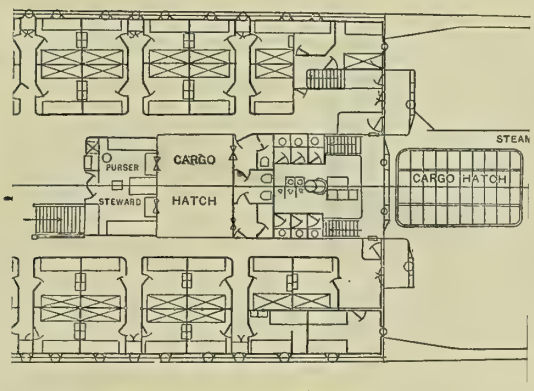

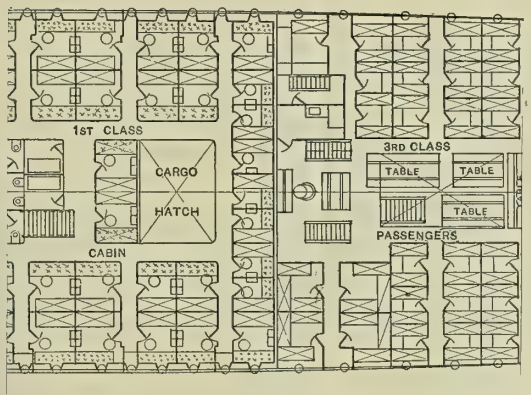

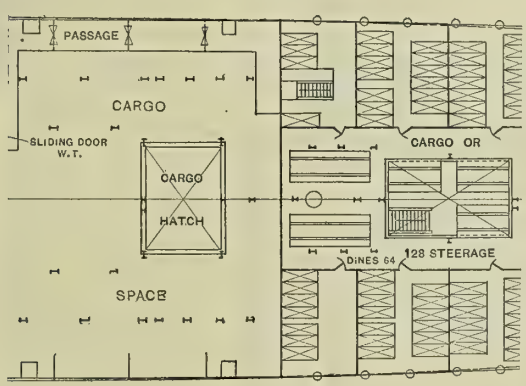

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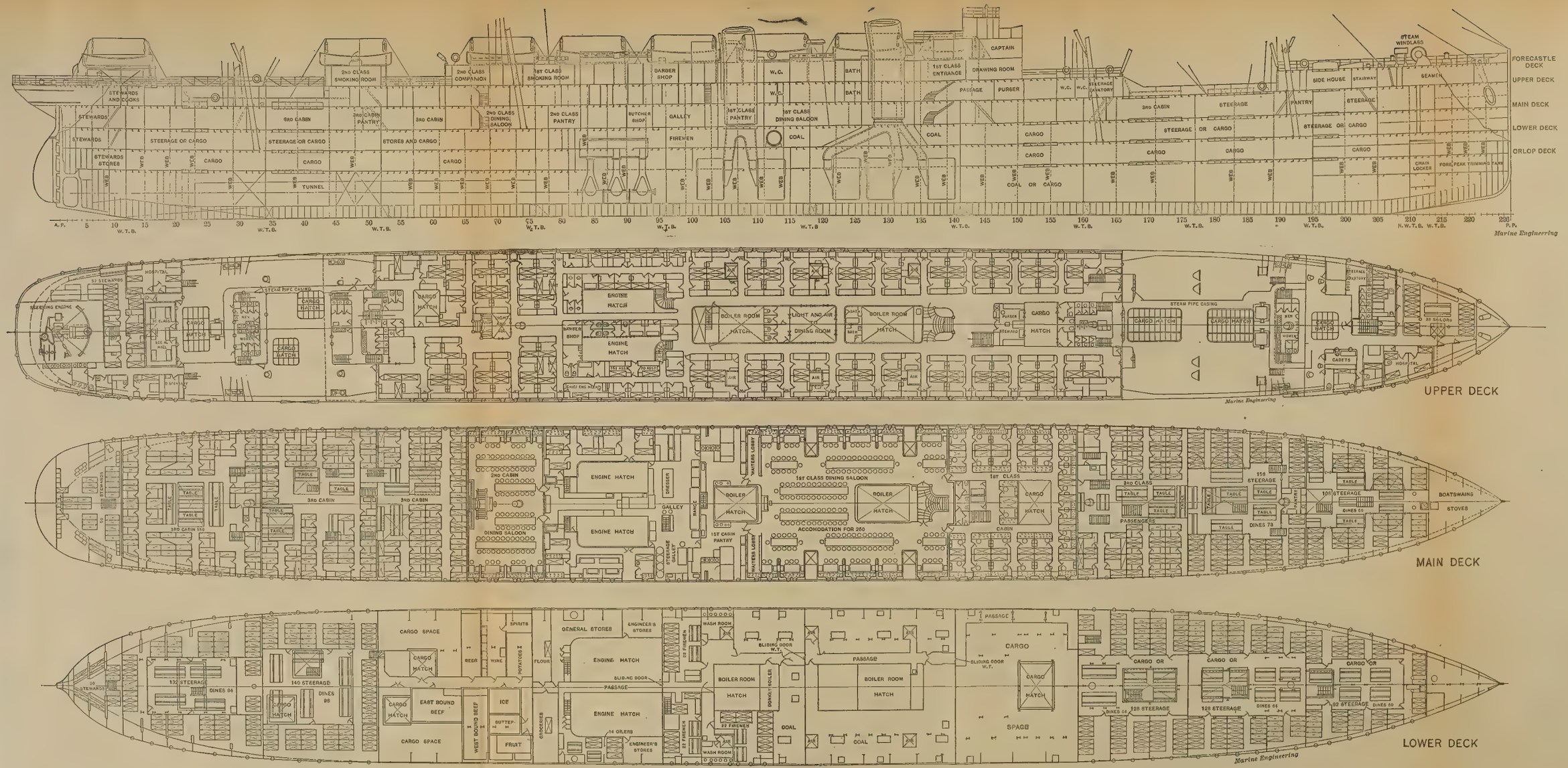


LONGITUDINAL ELEVATION AND DECK PLANS OF THE STEAMSHIP KROONLAND, BUILT BY THE WM. CRAMP AND SONS' SHIP AND ENGINE BUILDING COMPANY, FOR THE INTERNATIONAL NAVIGATION COMPANY.

of pneumatic appliances. As the *Kroonland* began to grow, so did the needs for new and varied tools; and as the needs became urgent they were met, until not a rivet in the hull could be considered too difficult for pneumatic tools to deal with. The result is that this ship is almost entirely pneumatic riveted, the hand-driven rivets being very few and far between and consisting only of odd rivets.

During construction this vessel was visited by some of the most prominent shipbuilders of Great Britain, who expressed their admiration for the methods and tools used and for the results obtained.

One of the interesting features of the design is the use of the long bridge house as a main part of the upper structure instead of making it a mere superstructure. It is said that the American type of steamer is flush-decked, and that all steamers built in America should be flush-decked; but it is a pity to limit American shipping to one type of ship, because different trades require different types; and, after all, commercial utility should decide whether a new ship is to be flush-decked or not. Suffice it to say that the *Kroonland* is not flush-decked and that the superstructure is made a main part of the hull.

The chief features with regard to the size of the ship are given in the appended tables.

The first and second cabin passenger accommodations are amidships. Both dining saloons are on the main deck; the state rooms are on the main and upper decks; and the special state rooms, smoking rooms, and drawing rooms are on the promenade deck.

The decorations of the first-cabin public rooms, which were designed by Messrs. Waring and Gillow, of London, have been well carried out by Messrs. Cramp. The first-cabin dining saloon is finished in white, Adam's style. It is seated for 250. A large dome skylight of decorated glass occupies the center of the ceiling, and is illumined at night by the electric lights above. The furniture is of inlaid mahogany. The drawing room is also white, Adam's style. It is paneled in green silk and furnished with inlaid satinwood tables, chairs, and settees. This room opens into the main companionway, which is framed and paneled in mahogany. The main stair leads from the promenade deck to upper deck, and from upper deck to first-cabin saloon. All the stairs in the first cabin are mahogany, with mahogany rails and balusters and white rubber treads.

DECK VIEW, STEAMSHIP KROONLAND, LOOKING AFT ON PROMENADE DECK.

At the end of the first-cabin house on promenade deck the first-cabin smoking room is placed—a large room finished in Elizabethan style, from designs by Messrs. Waring and Gillow. The sides and beams are fumed oak, the ceiling panels are buff, and the large central skylight covering the greater part of the room is glazed with ornamental leaded glass and decorated in bold Elizabethan relief. The upholstery is red-stamped leather, and deck is covered with American rubber tiles.

All the first-cabin accommodations on the promenade deck are within the deck house, which is 195 feet long. In ships of the size of the modern transatlantic liner it has been found impossible to maintain a long house on the uppermost structural deck without great annoyance to passengers from leaks, and without considerable expense to the shipowners repairing the fractures which from time to time, as the voyage is more or less stormy, appear in the sides and top plating of such houses. It is the usual practice with those who try to avoid these troubles to cut the promenade deck house into sections, quite apart, leaving passages of at least a beam space between them. This interferes greatly with the arrangement of the ship, and causes inconvenience to passengers and loss of efficiency in the steward department of the ship. But it is the practice of the owners of the *Kroonland* to maintain the long promenade house, and yet avoid the troubles above mentioned, by fitting at intervals a flexible joint in the house, a device designed by a member of their technical staff several years ago and successfully used on all their larger ships. By this means the strains on the house are localized and prevented from disturbing the sides or top of the house.

The second-cabin promenade is railed off from the first-cabin promenade on the same deck. On it the second-cabin passengers have a large companionway, a ladies' room, and a smoking room. The companionway is in oak and is fitted up with lounges handsomely upholstered. The ladies' room opening off the companionway is finished in maple. The smoking room may be reached from the deck below by stairway from the main passage or from the promenade deck at the after end. This room is finished in mahogany and is handsomely furnished and upholstered in brown leather. The deck is laid with rubber tiles.

All the houses on promenade decks are lighted by Mullan's patent square light with ventilator on top. These lights are probably the best deck-house ports to be had. They combine the maximum of opening with the greatest security from leaking. There is, however, no need to open ports on the *Kroonland,* two complete systems of ventilation, the one supplying and the other exhausting air, being fitted throughout the accommodations for cabin passengers, after steerage passengers, and crew. To this we shall return shortly.

LAUNCH OF THE KROONLAND FROM THE YARD OF WM. CRAMP AND SONS' SHIP AND ENGINE BUILDING COMPANY.

All the first-cabin state rooms are painted white enamel, furnished with mahogany, and upholstered in tapestry or moquette. All the large state rooms have a double and the others a single wash cabinet of improved design, with folding table attached. The berth fittings, including racks for clothing, etc., are nickel plated, and every room has a large number of nickel-plated hooks, sponge racks, etc. The upper berth folds up, and in many cases the lower berth folds out to form a double-width bed. All the ports are fitted with spring

shades, and the deck is covered with velvet pile carpet in the state rooms and passages.

The International Navigation Company has always made the second-cabin accommodations a special feature of their ships. In the *Kroonland* this practice has been well maintained. The second-cabin state rooms are similar to those of the first cabin, except in details, such as the folding beds, upholstery, and carpets. The second-cabin dining saloon, ladies' drawing room, and smoking room are fully up to the standard set in the *St. Louis* and the *St. Paul.*

There are two classes of steerage passengers—third class and steerage. The third class are located in the separate rooms for the petty officers and engineers. The captain and officers occupy the large house on the boat deck at the flying bridge, and the chart room and wheel house are on the bridge itself. Access to the bridge is sheltered by steel screens.

On the boat deck, which is carried along abreast of all the houses on the promenade deck, the life-saving appliances, in the form of boats and rafts, are fitted in number and capacity beyond the requirements of the American, British, and Belgian laws. Instead of the usual wooden boat chock, Wilson's patent collapsible boat chocks, supplied by the James Reilly Repair and Supply Company, are used. The boat is quickly freed

FIRST-CABIN SMOKING ROOM, STEAMSHIP KROONLAND.

Nos. 3, 5, 6, and 7 compartments of the main deck, and the accommodations provided consist of state rooms with folding beds, seats, mirrors, etc. Large dining tables with hardwood settees are fitted, and four pantries with hot tables, boilers, and all the usual fittings of a ship's pantry are provided. In each steerage companionway the lavatories and closets are placed. Solid porcelain bath tubs are provided, and all the lavatories have porcelain basins, with hot and cold water. The third-class quarters are ventilated mechanically.

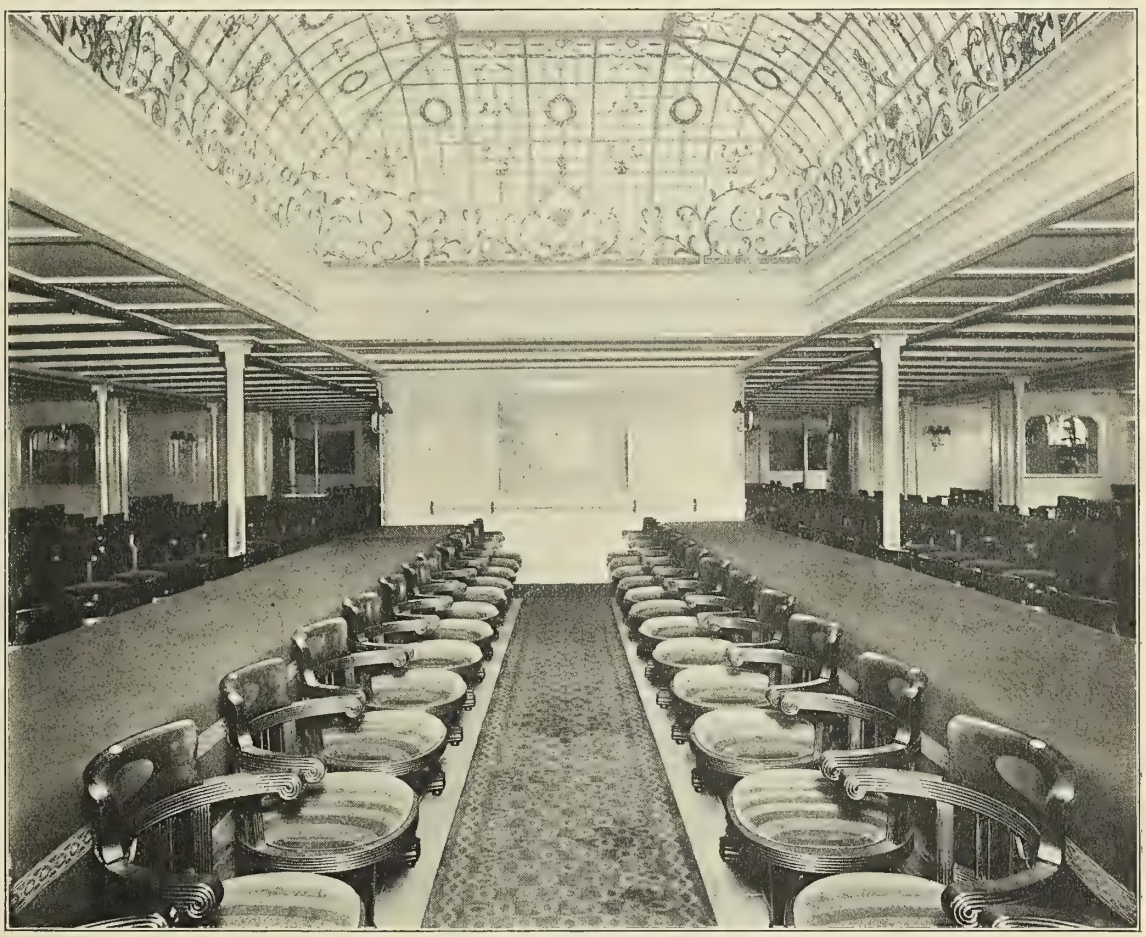
Accommodations for the crew of 260 men are fitted under the forecastlehead, under the poop, and on the main and lower decks aft. Lavatories and shower baths are fitted for the stewards, sailors and firemen, with

from these chocks by pulling a lever, the mechanism not only freeing the boat and leaving it hanging, but also turning down the chocks on the deck. A boat winch with double drums for hoisting the boats is fitted on the boat deck, and the davit falls can be led to this winch through fairleads placed on deck at the davit and thence by way of lead blocks. The auxiliary boats are placed on rolling skids, which, when the boat under davits has been lowered, carry their burdens of Chambers' collapsible boats under the davits.

Besides the life-saving appliances the ventilating and heating apparatus is placed on the boat deck. A double system of supply and exhaust is fitted. One set of Sturtevant electric fans delivers fresh air through steam

coils to air ducts leading through the ship, and another set of fans exhausts the air from ducts brought from each state room and other space. Air is delivered in the passage alcoves and public rooms and is exhausted from the state rooms, public rooms, etc. The capacity of the apparatus provides a change of air every fifteen minutes.

The sanitary system is very complete. There is a hot as well as a cold-water service, with separate pumps and delivery pipe to reservoir tanks on the boat deck, and distributing pipes thence throughout the ship. In addition to the fresh-water system, supplied from the six large storage tanks in the after holds through the



DINING SALOON, FIRST CABIN, STEAMSHIP KROONLAND.

fresh-water pump in the engine room, there is a complete condensed-water system with separate pump, supplying the reservoir tank on boat deck and led forward and aft to steerage and crew lavatories.

The ship's store rooms are on the lower deck, and include separate refrigerator rooms for meat, vegetables, and fruit, butter and milk, beer and ice, besides large rooms for groceries, barrels, potatoes, and general stores.

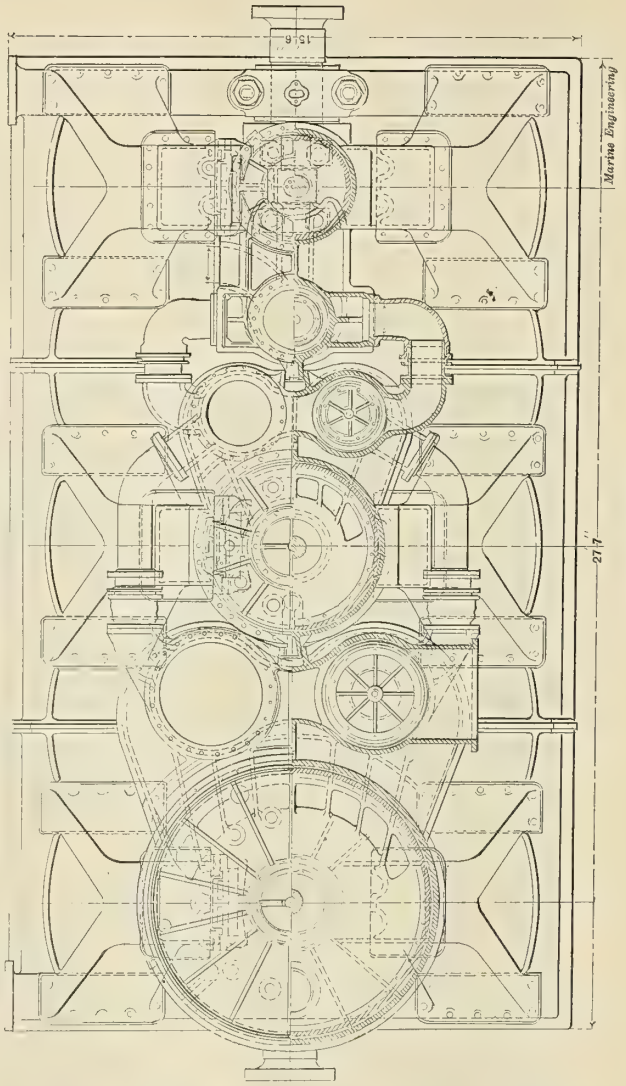
Structurally the *Kroonland* is interesting. There are four complete hull decks and the promenade deck, which runs for more than half length amidships. The forecastle deck is 88 feet long and the poop is 65 feet. The boat decks are light but substantially built above the promenade deck. All these decks, except the boat and orlop decks, are completely steel plated, and all are laid with wood. The beams are steel channels on every frame, with three rows of stanchions and channel ties. In addition to the four decks, web frames spaced 12 feet, except in the machinery space, are fitted all fore and aft. In connection with the webs two deep hold stringers are fitted between the webs, to which they are united by large diamond plates and double angles. Special attention has been given to the forward framing to prevent panting, where additional webs, breasthooks, and stringers are fitted.

The ordinary frames are channels, and extend from margin of double bottom to promenade and to the upper decks, forward and aft of the promenade deck. For one-eighth of the length at each end angle frames are used, these being somewhat easier to work where the bevel is excessive. In the double bottom, which extends from fore-peak to after-peak, the floors are solid plate, united to outside and inside plating by double angles in way of engines and boilers, and single angles elsewhere. Solid intercostals are fitted between the floors. The interior of the double bottom is coated with bituminous and Portland cement. The inner bottom plating has been made unusually heavy, because wooden ceiling is not fitted except under the hatchways. The fore-peak is fitted as a trimming tank.

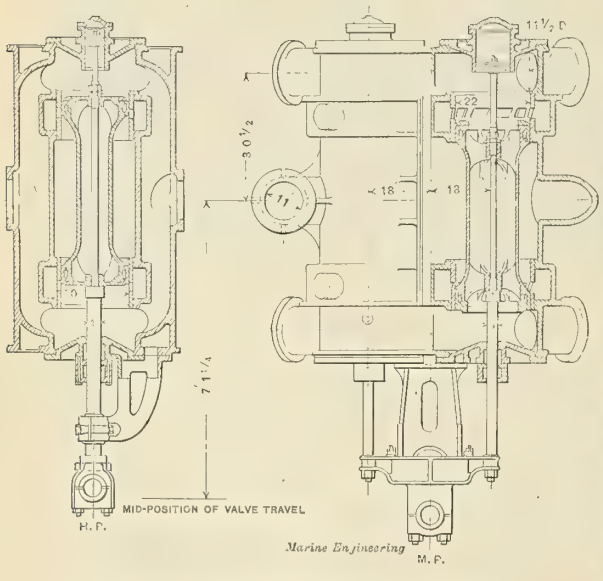
There are eleven water-tight transverse bulkheads

NAME—Krooland. NATIONALITY—American. TYPE—Passenger and Freight Steamship.
LAUNCHED—1902. BUILDER—Wm. Cramp & Sons' S. and E. Company. OWNER—International Navigation Company.

Length over all	560 ft.
" between perps	560 ft.
Breadth molded	60 "
Depth "	42 "
Draft, load	31 "
Corresponding displacement	22,100 tons.
Block coeff.	.742
Cargo capacity	600,000 cu. ft.
Coal bunker	2,000 tons.
Water ballast	2,000 "
Engines, number	2
Type	Three cylinder, triple.
Cylinder diameters	32½, 54, 89½ in.
Stroke	54 in.
Valves	All piston.
I. H. P. on 12-hour trial	10,200
R. P. M. " " "	89.
Condensing surf 2 main	14,000 sq. ft.
Shafting, diam. crank	16¾ in.
Tail shafting	18¼ "
Boilers, number	9
Type	Single-end Scotch.
Pressure	170 lbs.
Diameter	15 ft 10 in.
Length	10 " 5½ "
Furnaces in each	4 Fox
Diameter inside	39 in.
Length of grate	5 ft. 6 in.
" " tubes	7 " 0 "
G. S. total	643.5
H. S. "	22,400 sq. ft.
Draft	Cramp's forced.
H. S. ÷ G. S	34.8
H. S. ÷ I. H. P	2.2
I. H. P. ÷ G. S	15.8
Donkey boiler, size, 6 ft. diam by 7 ft. long.	



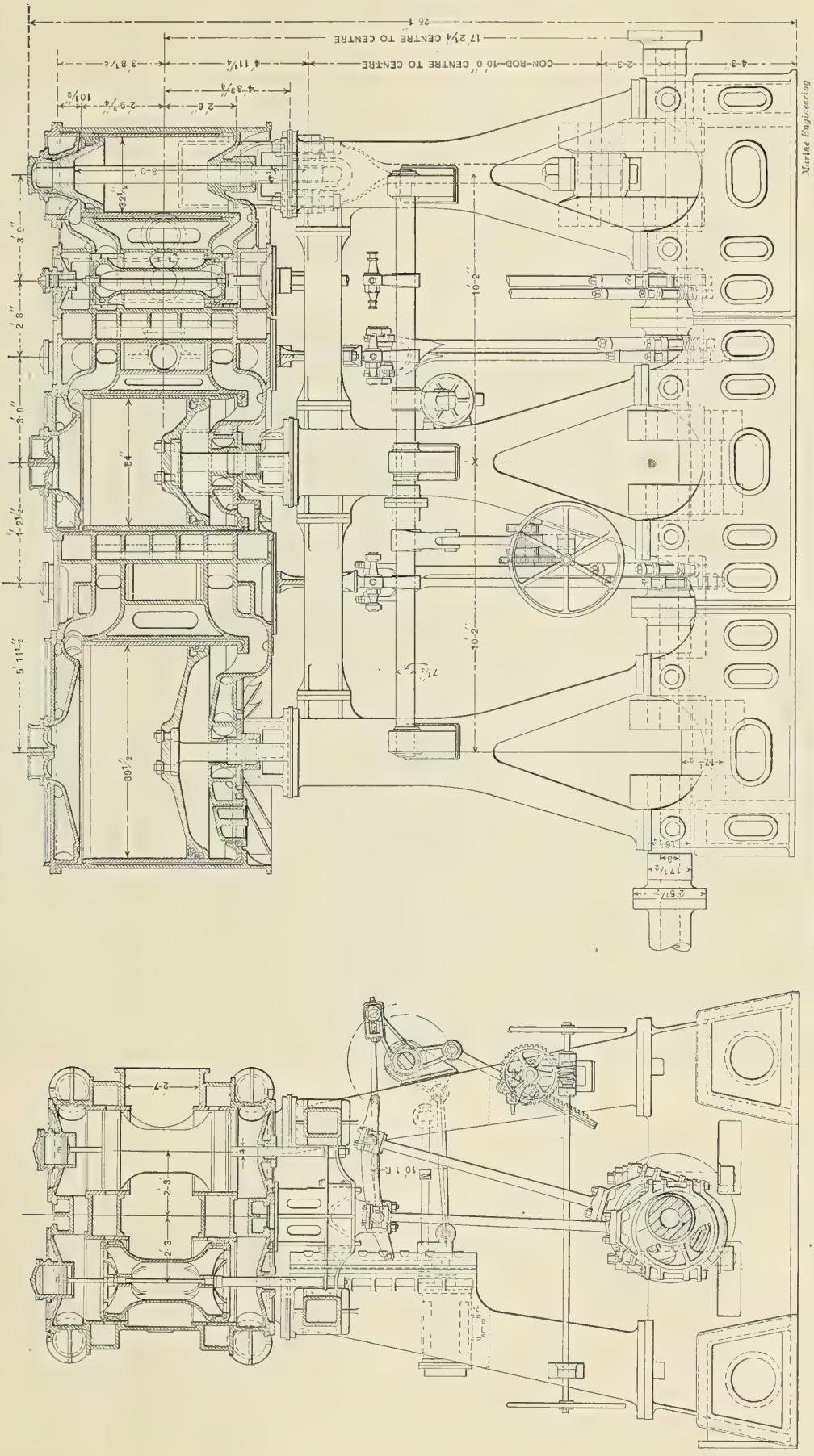
PLAN OF CYLINDERS.



HIGH AND INTERMEDIATE PRESSURE VALVES.

carried to the upper deck, dividing the ship into compartments, any two of which (and in many cases three) might be flooded simultaneously without endangering stability or sinking the ship. These bulkheads fulfill all the recommendations of the Bulkhead Committee appointed by the British Government to report on the best methods of promoting the safety of ships by the use of water-tight bulkheads. The necessary bulkhead doors in the machinery space are of steel plate with brass frames; and they can be operated from the upper deck by gearing, so that in case of any accident the doors may be closed from above.

The stern post and propeller brackets and the lower part of the stern are steel castings; and the rudder is one steel casting, including the blade and the gudgeons for the pintles. The rudder stock is an ingot steel forging coupled to the rudder with six large bolts. The rudder is carried at the upper deck on a white metal bearing of large surface, arranged to be easily removed and overhauled. All the pintles are brass sheathed and fit in lignum vitæ bushes in the gudgeons. Above the upper deck the main and auxiliary tillers are fitted on the rudder head in connection with Brown's patent steam-steering gear. These tillers are of cast steel. In addition to the steam and hand gear, relieving tackles



ONE OF THE THREE-CYLINDER TRIPLE-EXPANSION ENGINES FOR THE STEAMSHIP KROONLAND.

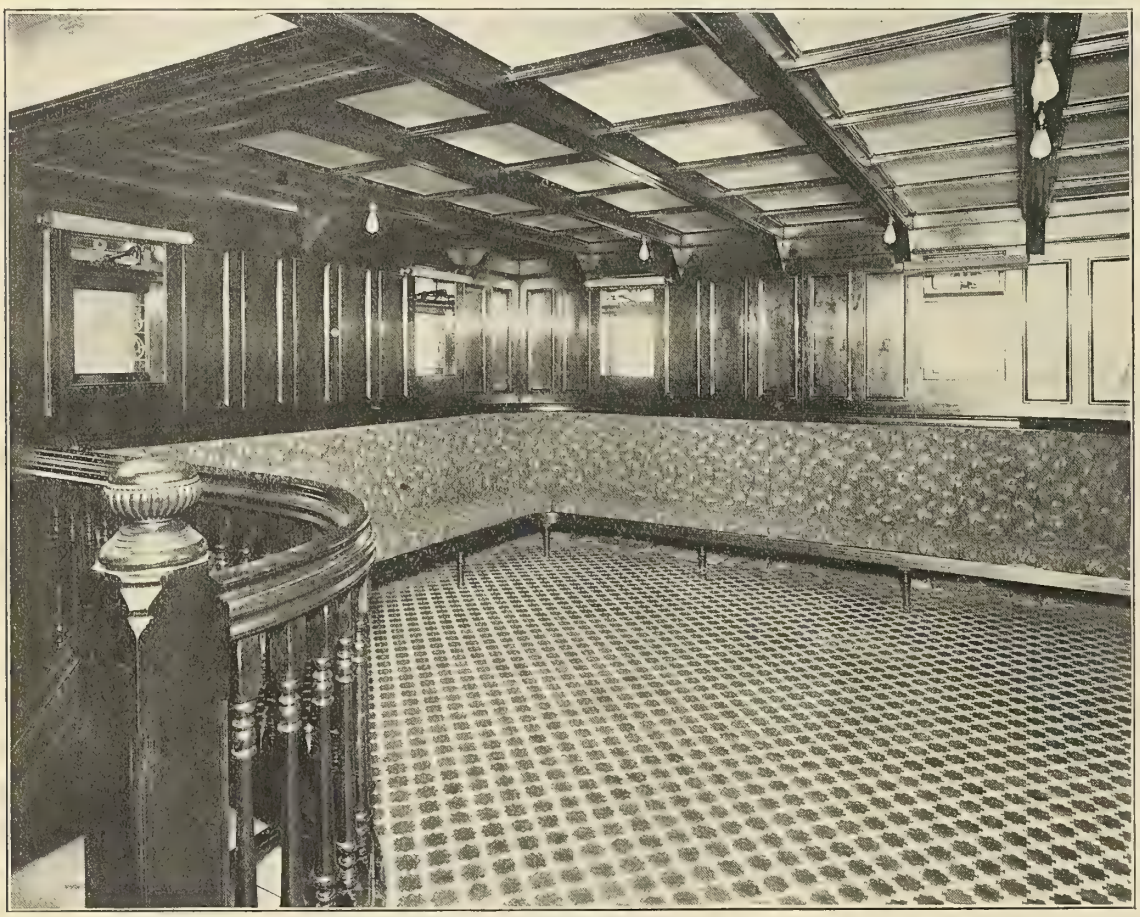
are provided and emergency wire rope gear for use directly on the rudder in event of a fracture of the rudder stock.

The warping gear consists of two large independent steam capstans on the poop, and three large capstans (two independent and one connected to the windlass) in addition to two drums on the windlass on the forecastlehead. These, together with the steering gear, were all supplied by the Hyde Windlass Company. Fourteen helical-geared, double-drum cargo winches are fitted, to be driven by steam at boiler pressure.

Electricity for lighting and power is provided by four 350-ampere generating sets made by the Electro-Dynamic Company. These supply power for the thirteen motors driving the fans for ventilating the passenger and crew spaces and for 1,600 lights throughout the ship. The dynamos are on the orlop deck abaft of the engine room, where they, along with the refrigerating plant, occupy a space the full width of the ship and 15 feet fore and aft. Mechanical ventilation is provided to the dynamo room, and in addition there are two large natural ventilating trunks led from the boat deck, where they are fitted with cowls.

Cochran refrigerating machinery for controlling the temperature of the ship's store rooms is installed. Each room is separately controlled from the refrigerating machinery room, brine pipes being led from manifolds to each room and returned.

The ship is propelled by twin screws driven by two sets of triple-expansion engines balanced on the Cramp principle. The diameters of the cylinders are 32 1-2, 54, and 89 1-2 inches, and the stroke is 54 inches. The steam pressure is 170 pounds. Piston valves are fitted on all cylinders and the valve gear is of the link type. The bed plates and columns are cast iron of ample strength. The crank-shaft bearings are lined with Parsons' white brass, and bushes are round-backed and easily removed when the shaft is in place. The crank shafts, of 16 3-4 inches diameter, are interchangeable, and the line shafts, 15 3-4 inches, are fitted with two of the Verity patent flexible couplings on each line.



ENTRANCE HALL, PROMENADE DECK, STEAMSHIP KROONLAND.

These couplings are intended to prevent strain of the shafting in event of the shaft from any cause becoming out of line. The tail shafts, 18 1-4 inches diameter, are covered with brass 1 inch thick.

There are two separate condensers, one for each engine, made of cast iron, with brass tube plates. The tubes are 3-4 inch diameter, and give a cooling surface in each condenser of 7,000 square feet, or 1.4 square feet per I. H. P. A circulating pump is fitted for each condenser, and the port and starboard pumps are cross-connected, so that either pump may be used for both condensers in event of one pump being stopped. Separate air pumps of the Blake featherweight pattern are provided, one on each side of the ship, and these pumps are also cross-connected.

Steam is supplied by nine single-end Scotch boilers, 15 feet 10 inches in diameter by 10 feet 5 1-2 inches long. The boilers are all placed 'thwartships. In the after boiler room are four boilers fired from one floor. In the forward compartment are five boilers, four of them being placed back to back 'thwartships and the fifth one forward of the center line, thus making two fire rooms, viz: one for the after two boilers and one for the forward three boilers. Coal is supplied through wing and 'thwartship bunkers.

In each boiler there are four Fox furnaces 39 inches inside diameter and 7 feet long, giving a length of grate steel bends and branches; the smaller pipes are copper. Drainage of the steam pipes is thoroughly carried out, and the Holly system of drainage is fitted to the main steam pipes. The main steam pipes are led from the boilers along each side of the ship to the engine room, where they are connected; and valves are arranged so that both engines may be supplied from either one or the other of the pipe lines. The auxiliary steam-pipe system is taken from boilers in each fire room, so that the boilers used in port may be alternated.

The propellers have steel bosses and bronze blades. Steam trials were made on the measured mile in Dela-

LADIES' ROOM AND LIBRARY, STEAMSHIP KROONLAND.

5 feet 6 inches. Separate combustion chambers are fitted to each furnace, and the furnace mouths are flanged inward to enable the furnace to be easily removed. The tubes are 2 3-4 inches diameter by 7 feet long, fitted with retarders. The boilers are equipped with Cramp's system of forced draft, being operated by steam-driven fans, two of which are placed in the after stokehole and three in the forward stokehole.

There are two main and one auxiliary feed pumps, by Worthington, drawing from hot-well and feed heater, with two separate delivery pipes to the boilers with separate checks on the boilers. Evaporators with a capacity of 65 tons per day are fitted.

The main steam pipes, of steel, are used with cast-

ware bay, and afterward at sea before the ship was delivered to the owners.

The *Kroonland* has now made four voyages and has given great satisfaction. Her sister ship, the *Finland,* was launched from the Cramp yard in June of this year and will soon be placed in commission.

Wireless Telegraphy.—Successful experiments in applying wireless telegraphy to submarines have been made at Cherbourg, France. The submarine *Triton* was fitted with a mast and receivers, and, after plunging below the surface, received signals transmitted from the central submarine station with perfect clearness. The system used has been invented by Lieutenant Tavi.

Shipping Commissioners Report.

Reports to the Bureau of Navigation show that during the past fiscal year, Shipping Commissioners at the seaboard shipped 108,554 men on American vessels. Of this number 65,859 were shipped on steam vessels; 42,695 on sail vessels. In the foreign trade 49,060 men were shipped; in the coasting trade 59,494. These figures include the repeated shipments of the same men on different voyages of the same vessels. The number of individual seamen involved did not exceed 20,000. The nationality of the men shipped was: Born Americans, 34,957; naturalized Americans, 14,915; Norwegians, Swedes, and Danes, 16,315; British, 13,897; Germans, 5,640; Italians, 2,297; French, 576; other nationalities, 19,957. These figures also include repeated shipments. Chinese are not shipped on American vessels in American ports, but 521 were shipped at Hong-Kong before United States consul.

The amount of wages disbursed during the year under Shipping Commissioners' supervision was approximately $2,500,000. The average monthly wages paid to men of all ratings, excluding masters, during the year on American vessels was: Passenger steamers, $36.88; freight steamers, $42.46; square-rigged vessels, $28.94; schooners in the foreign trade, $29.12; schooners in the coasting trade, $33.63; the average wages for all being $35.11, or usually $316 a year. In American ports 3,993 men, or less than 4 per cent., failed to join their vessels.

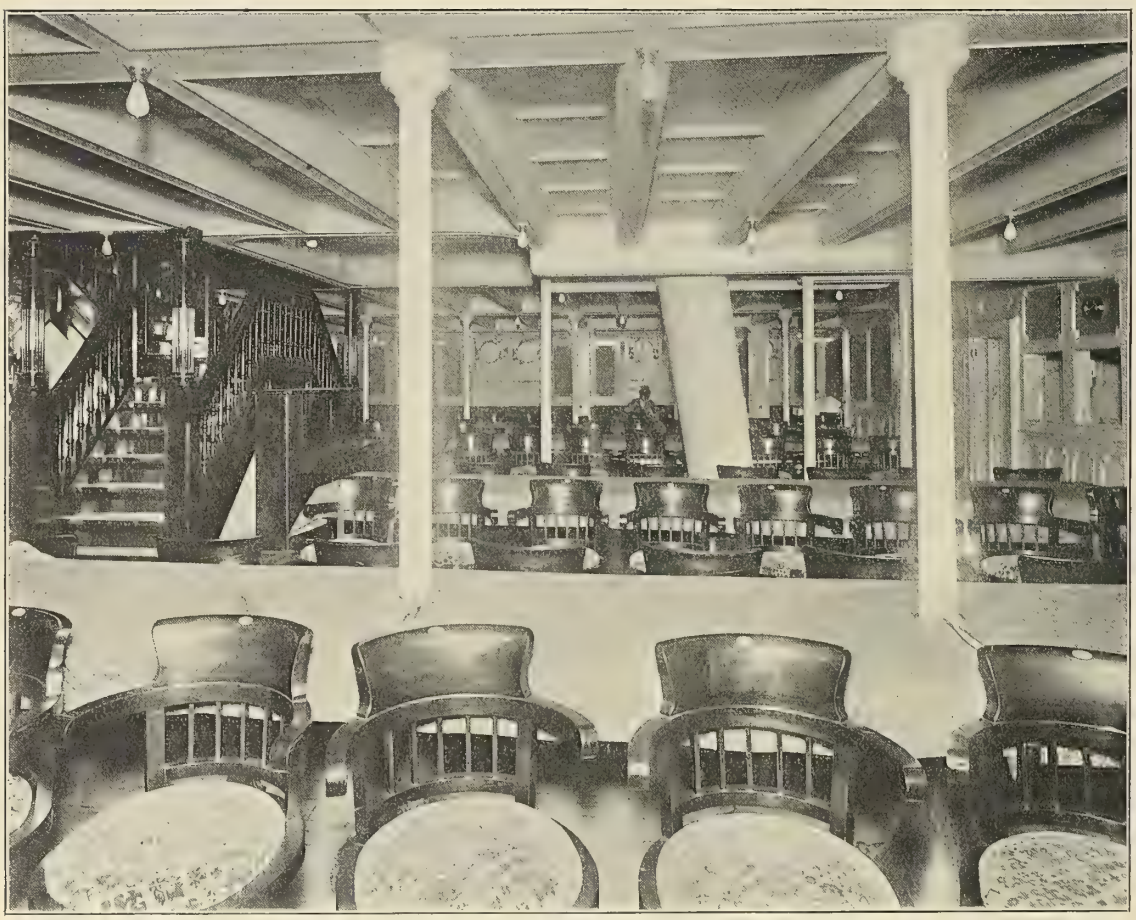
Electrically-Operated Canals in Belgian Coal Mining Districts.

BY FRANK C. PERKINS.

It would not be surprising if, within a few years, the principal canals in this country, as well as those abroad, were electrically operated, as this method of propulsion is not only very convenient and economical, but also may be made to greatly increase the traffic, on account of the increased speed thus made possible.

The development of electric haulage on canals is slow, but some interesting experiments have been made in this line in Europe; one of the most successful, although working under great disadvantages, is that on the Charleroi Canal in Belgium. This electrically-operated canal serves the Charleroi coal mining region in Belgium with more or less success. The conditions limit the speed and economy, but these could be greatly improved on with an entirely new and modern equipment and a deep and well-constructed waterway.

The experiments on the Erie Canal in New York State, while not in every way successful, demonstrated the fact that electric propulsion is not only possible in this country, but, with plenty of water power at various points on the line, might be made very efficient, as compared with the present methods with horse, mule, or even steam canal-boats. The new power house at Niagara Falls on the American side is nearly com-



SECOND-CABIN DINING SALOON, STEAMSHIP KROONLAND.

pleted, and will add 50,000 horse power more to the present development of the Niagara Falls Power Company, making a hundred thousand horse power for transmission and distribution, with a possible 100,000 horse power more from the same tunnel as a tail race. Another 100,000 horse power is available from the power canal passing through the city of Niagara Falls on the surface, while the Canadian Power Company has already let contracts for a number of 10,000 horse-power turbines and generators, and when completed this plant will add 200,000 horse power more. It will thus be seen that practically half a million horse power is already in sight for electrical power transmission in and about Niagara Falls, Western New York, and Canada. It will, therefore, be surprising if the Erie Canal, as well as the Welland Canal in Canada, are not looked to in the near future as users of this power; and electrical canal haulage will without doubt increase the traffic of ore and coal from the mining regions about the Great Lakes.

The coal mining regions of Belgium, in the Charleroi district, are connected with Brussels and Antwerp by the Charleroi electric canal, which is a narrow waterway about 50 miles long. There are two central power stations, one at Oisquercq, 15 miles south of Brussels, and another at Roux, 6 miles north of Charleroi. These stations are 29 miles apart, and the former is equipped with three 125 horse-power Corliss engines, each driving a polyphase alternator constructed by Brown, Boveri and Company, of Baden, Switzerland. These machines supply an alternating current of 15 amperes each, at a potential of 6,000 volts.

The power station at Roux is of larger capacity, the engines and generator sets having a capacity of 325 horse power each, as they supply current for lighting and industrial purposes, as well as for operating the canal apparatus at various points along the line.

There are sub-stations located at points along the canal about three miles apart. Each of these contains a step-down transformer, which lowers the pressure from that on the transmission line, or 6,000 volts, to that used on the trolley line, or 600 volts.

This electrical haulage system was designed and constructed under the direction of Leon Gerand, the consulting engineer of the Compagnie Générale de Traction Electrique sur les Voies Navigables, to whom the writer is indebted for the information regarding this electrically-operated canal.

CHARLEROI ELECTRICALLY-OPERATED CANAL.

The "tracteurs," or electric automobiles, one of which is seen in detail on page 446, are used to draw canal-boats in the same manner as horses or mules, and each has a capacity of about five horse power. They work over sections of various lengths, and when they meet another going in the opposite direction they do not pass each other, but exchange tow lines and return with the boat they meet; the outfit not being turned around, but the operator simply changing his seat and facing in the opposite direction, the controller still being within easy reach, as seen in the accompanying drawing.

The banks of the canal are so narrow and in such poor condition for much of the way that electrically-operated tugboats are also employed, as shown above, which have a speed of 8 miles per hour. An

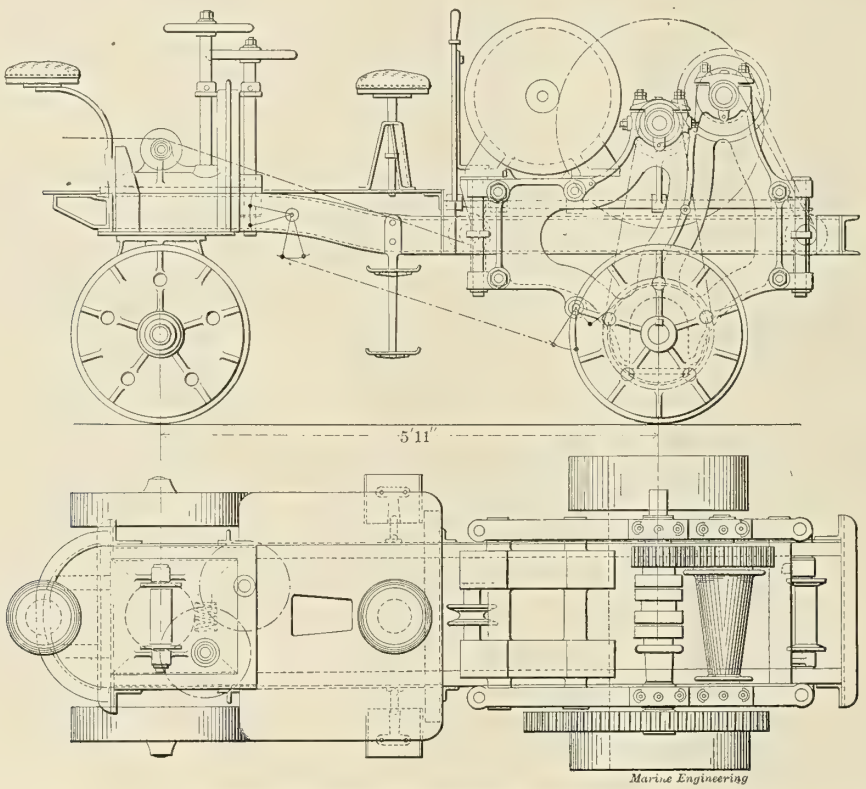
insulated cable conveys the current to the boat from a three-phase trolley line, in the manner indicated in the illustration, this cable being supported from a pole attached to a mast on the boat, and trolley device of the peculiar construction shown, which seems to operate at speeds of 6 and 8 miles per hour without trouble, although a speed of only 2 miles per hour is used in towing two 70-ton boats. The mast is about 14 feet above the water, and the boat can travel at a distance of 50 feet or more from the line and is free to turn around and manœuvre similarly to a steam tugboat. The boats have a capacity of 70 tons, with a draft of only three feet, and are greatly hampered by the depth of water, which is only about 3 1-2 feet. On account of the narrow path, and heavy and irregular loads due to this small depth of water, with considerable mud on the bottom, the speed is low and the amount of energy required is comparatively large, the necessary current being about 6.5 kilowatt hours per boat mile, although this has been lowered to 5.5 per boat mile, while the mean traction pull is 350 pounds, and the maximum 1,320 pounds.

It was of considerable importance to more efficiently connect Brussels with the Charleroi coal district, and the electrical haulage has done this satisfactorily, considering the conditions of the canal, increasing the speed of towing from 1 1-4 miles per hour, which was the rate of speed with horses, to 2 1-2 or 3 miles per hour with the electric system, and with no additional cost per mile for an equal tonnage, which averages about 25 cents per boat per mile. The total traffic per year amounts to more than half a million tons.

The motor car, or tracteur, is equipped with a winch, which may be electrically operated from the motor axle, which the operator can disconnect from the wheels; and by this electrically-operated winch a stranded boat may be relieved, and a boat may be forced out of a lock. With the electrical method of haulage the passage of a lock may be made in less than five minutes, while it took three times as long for the passage of a lock previously with horses on the Charleroi Canal.

The Mons district is connected to the sea only through French territory, but the Liege district is connected by both river and canal over a trifle more than 100 miles, and Brussels is about 30 miles from Antwerp along the canal.

Considerable has also been done with electric propulsion of canal-boats both in Germany and in France, on the Finow, Aire, and Deule canals, the latter between Bethune and Douai.



ELECTRIC AUTOMOBILE FOR BELGIUM CANAL SERVICE.

Lloyd's Shipbuilding Returns.—From the returns compiled by Lloyd's Registry of Shipping it appears that, excepting warships, there were 406 vessels of 1,129,582 gross tons under construction in the United Kingdom at the close of the quarter ending June 30, 1902. This is a decrease of thirty-five vessels of 170,571 gross tons from the high-water figures of the corresponding quarter of last year. The falling off is chiefly in the districts of Greenock, Hartlepool, and Whitby, although all districts, except one, namely, Barrow, Maryport, and Workington, show a decrease, and this one shows an increase of from about 12,000 to 26,000 gross tons. The Glasgow district is about the same, and the Belfast district is but slightly less than last year.

REPORT OF RECENT OIL BURNING INSTALLATIONS ON THE PACIFIC COAST.

BY EDWARD S. HOUGH AND WM. H. CRAWFORD, JR.

In order to keep pace with the progress made in the use of oil for fuel, it is necessary to have reports from various parts of the world where this modern practice is being developed. The subject is by no means a new one, although new phases of it are continually presenting themselves to those engaged in the investigations.

It is not necessary to enumerate the advantages derived by making a change from the use of coal to that of oil for fuel. These are about the same everywhere, although in this part of the world particular emphasis can be laid on the item of economy in the first cost of the liquid as compared with the price of coal delivered here. California is fortunate in having its own oil wells and in being at no great distance from the largest oil fields in the United States, whereas coal must be imported, and in the past has come from British Columbia, Puget Sound, England, Australia, and Japan. There is probably no field where liquid fuel will find greater support than on the Pacific coast of the United States.

The following illustrations will give a fair idea of the experience gained in marine work at the port of San Francisco. They must necessarily be given in detail to enable those interested in the subject to figure out their own conclusions, should it appear that the deductions are not properly made. Three steamers will be considered, each under a separate heading. They are all small craft, but represent different types of installation. After these examples we will look into the case of an ocean-going steamer running between this port and the Hawaiian Islands, the first engaged on a long ocean run.

VESSEL NO. 1.

This example is a steam schooner built of wood for the lumber trade on this coast; she is intended particularly for the red-wood trade, taking her load in northern Californian ports and delivering in San Francisco and points in southern California. This vessel has, however, gone as far north as the Columbia river. She is 137 feet long, 34 feet beam, and 12 feet deep. Two fuel-oil tanks are fitted in the main hold immediately forward of the water-tight bulkhead, located forward of the main boilers, and two tanks forward, also under the main deck, between collision bulkhead and foremast. The total capacity of the four tanks is 15,000 gallons. The ceiling of the vessel under the tanks is lined with galvanized iron in the form of a trough, in order to catch any seepage which might occur from the oil tanks.

The oil system used is that of atomizing by compressed air. The tanks are double riveted throughout and are thoroughly well braced and partitioned internally, so that they will stand a pressure of 15 pounds per square inch without bulging the flat surfaces. All pipe connections are taken from the top, and only pressed-steel flanges are used, and these are riveted to the tanks and calked. There is an air-vent pipe taken from each tank to the atmosphere. The valves are so arranged that the oil pump can draw from any one tank, irrespective of the other three. The after tanks are filled through a 6-inch pipe, and the forward ones are filled through the manholes.

There are two main boilers, 8 feet 4 inches diameter by 10 feet long, of the Scotch marine type. The boilers were originally designed to burn coal and each contains 810 square feet of heating surface. There is one furnace, 46 inches in diameter, in each boiler. The tubes are 3 inches by 7 feet and are fitted with retarders. The whole of the furnace is effective as heating surface.

The engine is a two-cylinder compound, working on two cranks, with cylinders 14 and 32 inches in diameter and a stroke of 24 inches, working under 150 pounds steam. This engine can indicate 400 H. P. There are the following auxiliaries in constant running: an air compressor having two steam cylinders 6 by 6 inches and making 45 revolutions per minute; one centrifugal circulating pump engine, steam cylinder 4 by 5 inches; one large and one small duplex oil pump, and at night one electric generator engine, cylinder 5 by 5 inches. The large pump is used to draw oil from the fuel-oil tanks, thus leaving the smaller one to supply oil to the burners, acting as a force pump only.

The tank pump is a duplex Worthington, 4 1-2 by 2 3-4 by 4 inches, with a return pipe to suction. This pump draws oil from the tank and delivers to the intermediate receiver situated above the boilers. There is an intermediate oil receiver above the boilers between the tank pump and the oil tank. The force pump is a duplex Worthington, 3 by 2 by 3 inches, which takes oil by gravity from the intermediate receiver and delivers to the heater reservoir. The oil heater reservoir is detailed in the accompanying drawing and consists of a cast-iron shell with an internal heating coil of copper. This coil is made strong enough to allow of live steam being used for heating the oil.

There is a float with rod connected to a lever through a stuffing box. The lever is connected to the throttle valve of the force pump by a link, thus controlling the speed of the force pump and consequently the level of the oil in the reservoir. The reservoir is usually kept about one-half full of oil, the top half acting as an air vessel. There is a tandem duplex steam-driven double-acting air compressor, cylinders 10 1-2 inches air, 6 inches steam, by 6 inches stroke, with an air receiver 24 by 72 inches. The burners, which deliver a circular flame, are of local manufacture, two being fitted to each furnace.

The compressor delivers air at 15 pounds pressure to the top of the heater reservoir, and the force pump delivers oil near the bottom, and the balance is established, resulting in the burners being supplied with oil and air at equal pressure. The temperature of the heater reservoir will vary from 150 to 180 degrees Fahrenheit, the latter when using an oil under 20 degrees gravity. The temperature of the incoming air at the compressor is 100 to 120 degrees, and the volumetric efficiency of the compressor is 80 per cent. The actual quantity of free air delivered per minute is 43.28 cubic feet to the four burners.

It will be seen that in this case the piston speed of the compressor is low, therefore smaller cylinders

could be used, the piston speed being increased accordingly.

Temperature of oil at heater	150 to 180 deg.
H. P. to supply air for atomizing	3
Total power furnished by boilers	300
Power of compressor compared with main engine	1 per cent.
Water evaporated per min., calculated from indicator cards	102.5 lbs.

The compressor engines exhaust through the coil in the heater reservoir to the main condenser. Allowing 50 pounds water per I. H. P. per hour for these engines and the circulating engines, and 20 pounds for the main engines, we then have about 2 per cent. of the gross feed water required to supply air for atomizing. It is evident that by compounding the steam cylinders of the air compressor this can be reduced.

Consumption of fuel oil per hour	59 gals., or 472 lbs.
Fuel oil per I.H.P. hour	1.57
Water evaporated per pound of fuel per hour	13

VESSEL NO. 2.

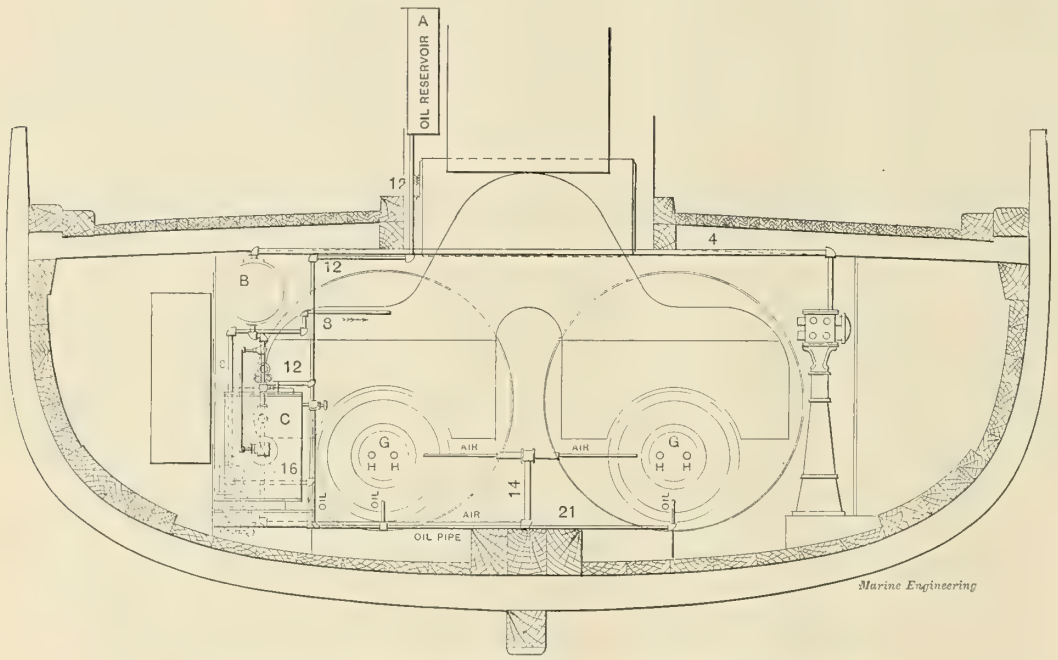
This vessel is also a steam schooner built of wood for the lumber trade on this coast, and is 160 feet long, 33 feet beam, and 15 feet deep. She carries two fuel-oil tanks, one on each side in the two fore and aft bunker spaces, with a total capacity of 17,000 gallons. The ceiling of the vessel under the tanks is lined with sheet lead to form a trough, as in the previous example.

The oil system used is the same as in No. 1, viz., atomizing by compressed air. The tanks are also of the same detail construction, the shape, however, being such as to conform to the bunkers. All pipe connections are taken from the top of tanks. The bunker plates next to the boiler are covered with magnesia non-conducting material 1 inch thick.

There are air inlet pipes to the bunker spaces about the tanks, and a suction pipe from the air compressor is carried to the bunker spaces. All the air required for the compressor is, therefore, taken through the bunkers, carrying with it any gases emanating from the oil, should leakage occur from the tanks. It also keeps down the temperature of the bunkers, which rises when the vessel has a deck load. In other respects the oil plant is a duplicate of example No. 1.

There is one two-furnace boiler 11 feet by 10 feet 6 inches, of the Scotch type, which contains 1,200 square feet of heating surface and was designed to burn coal.

The engine is a two-cylinder compound, working two cranks, with cylinders 14 and 32 inches diameter

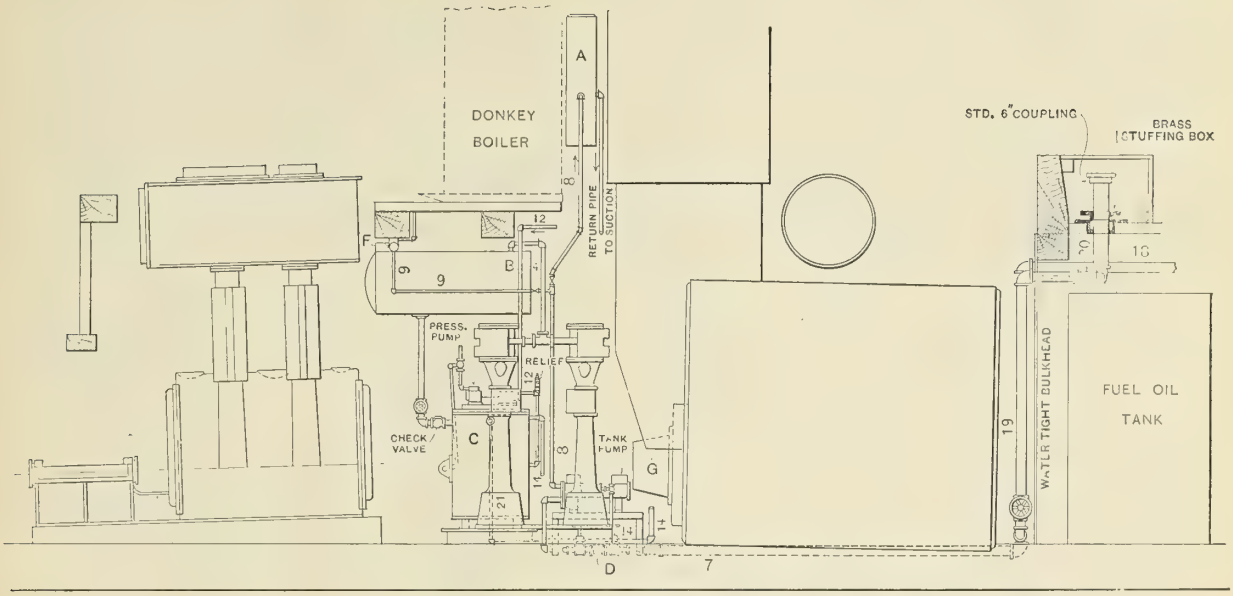


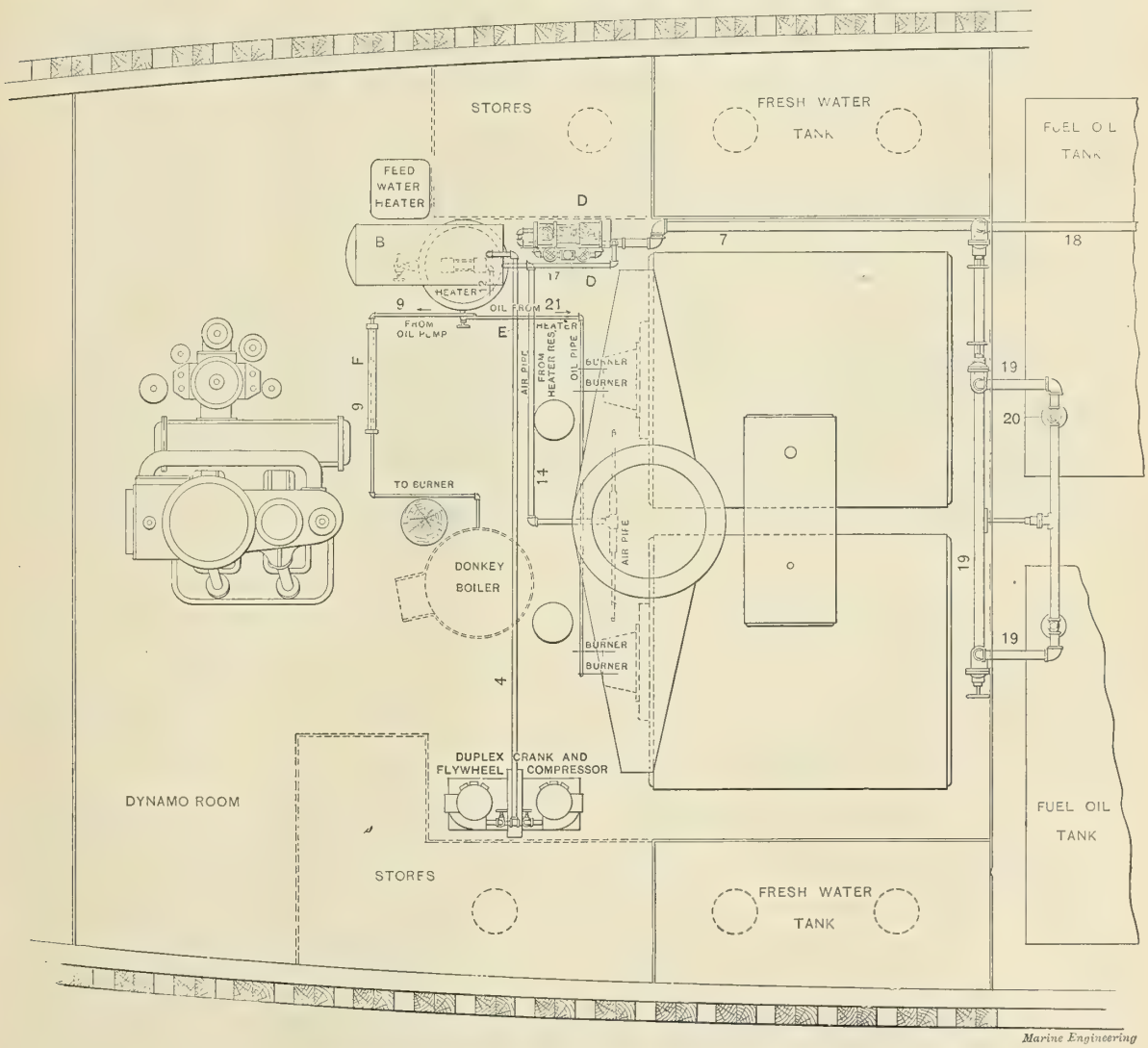
MIDSHIP SECTION OF STEAMER, SHOWING ARRANGEMENT OF FUEL-OIL PIPING.

SIZES OF PIPES IN DRAWINGS, PAGES 448-9.

1. 1 1-2 inches auxiliary steam.
2. 2 inches to heater.
4. 2 inches to air receiver.
5. Auxiliary steam.
7. 4 inches from main oil suction, 2 inches at pump.
8. 1 1-2 inches to oil reservoir.
9. 3-4 inch to heater for auxiliary B.
10. Auxiliary steam.
12. 1 1-2 inches from oil reservoir reduced to 1 1-4 inches at pump.
13. 1 inch to heater.
14. 2 inches air from heater reduced 1-2 inch at burner.
16. 1 1-2 inches return from oil reservoir to suction.
17. 2 inches air for tank below.
18. 4 inches from forward oil tank to main suction.
19. 2 1-2 inches from main oil tank to main suction.
20. 6 inches oil-filling pipe.
21. 1 inch oil from heater reduced to 3-4 inch at burner.

A. Oil reservoir.
B. Air receiver.
C. Oil heater.
D. 2-inch strainer.
E. Compressor.
F. Oil heater for donkey boiler.
GG. Extension fronts lined with fire clay.
HH. Holes for burners.





PLAN AND ELEVATION OF STEAMER, SHOWING FUEL-OIL PIPING.

by a stroke of 24 inches. Under 160 pounds of steam this engine indicates 400 H. P.

The auxiliaries are the same as in example No. 1. The above is given as an illustration of method of stowing tanks near boiler. Oil varies from 16 to 21 gravity.

VESSEL NO. 3.

This example is a modern stern-wheel steamer designed for bay and river service. Length 130 feet, beam 30 feet, and depth 7 feet 6 inches. There is but one fuel-oil tank, forward, and the ceiling under the oil tank is lined with lead.

This oil system consists in vaporizing the oil with the steam by passing the mixture through a furnace.

There are two plain tubular boilers, 60 inches in diameter and 18 feet long, each having forty-four 4-inch tubes. The boilers are designed for burning coal and for a steam pressure of 170 pounds. The engines are double tandem compounds, the two high-pressure cylinders being 12 1-2 inches diameter, the two low-pressure cylinders 26 inches, and all have a common stroke of 72 inches. These engines, including auxiliaries, develop on regular run 275 H. P.

The auxiliaries include one independent compound air and circulating pump, 6 by 12 by 10 inches; one compound feed pump, 6 by 12 by 6 inches; one electric light engine; one oil pump, 4 1-2 by 2 3-4 by 4 inches; two duplex Worthington pumps, 6 by 4 by 6 inches, working alternately, and one vertical heater and air vessel between pumps and burners.

There is one circular burner under each boiler, delivering through a pipe with flattened end, thus throwing a broad flame. The incoming air for combustion, taken through the burners, is passed through a pipe secured in the uptakes. The temperature of the air is thus raised to 330 degrees before entering the furnace.

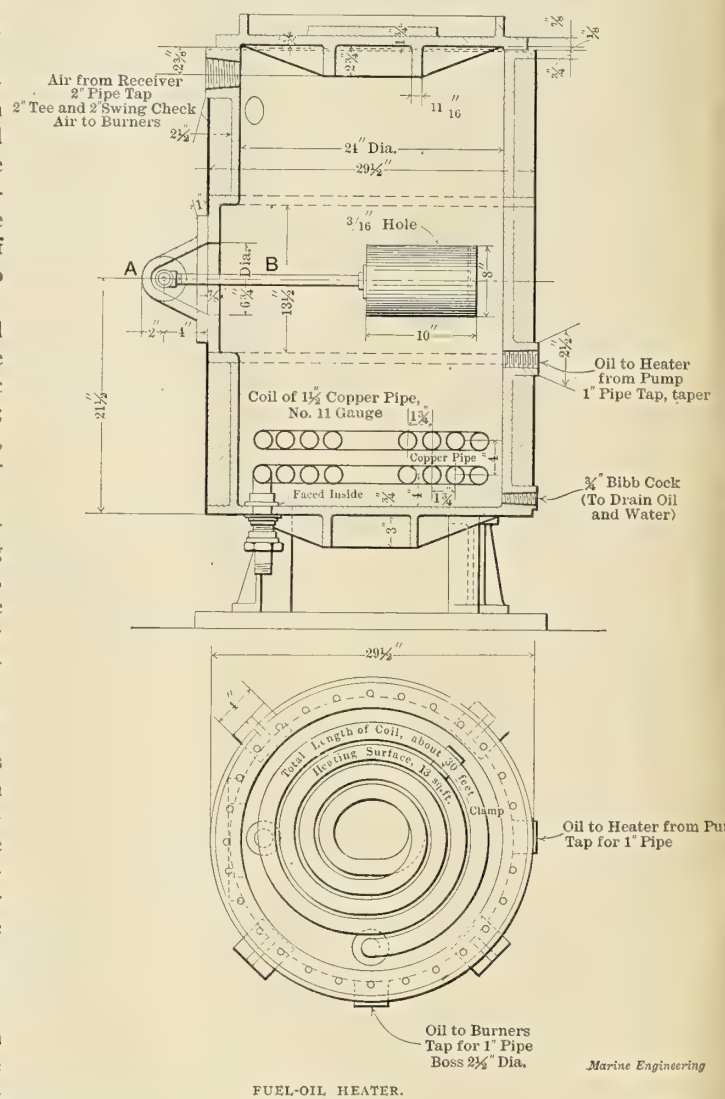
Consumption of oil per hour..... 73 gals.
Weight of oil consumed per hour.....584 lbs.

Unfortunately, reliable information on the subject is hard to get, inasmuch as the great saving made in adopting the oil-burning system has for a time satisfied shipowners, so that the further economy of one system of atomization over the other has been a neglected point. The economy of oil fuel, however, over that of coal is assured. Whether it is better to use compressed air for atomizing the oil, or to use steam and fit a ship out with adequate evaporators, is still an open question.

In the examples just considered we are able to begin an argument. As a check on some of the data we can look to a recent test on the Southern Pacific Railroad, where it was desired to determine the amount of steam required to atomize the oil used in evaporating a given quantity of water. There were two series of tests, and it was shown that 3.4 per cent. in one case and 3.8 per cent. in another of the gross feed water was consumed at the burner.

Regarding our example of an ocean-going oil burner we have some interesting information from Chief Engineer Coryond Lamond.

This steamer is provided with two single-end, three-furnace boilers, and a donkey boiler. Her engines develop about 900 H. P., the cylinders being 25, 38, and 72 inches, with a 48-inch stroke. She is a freight boat with limited passenger accommodations, hence the electric-light plant is comparatively small, which, with its auxiliaries, does not add much to the work of the boilers. There is also a refrigerating apparatus. This ship was fitted out with a compressed-air system, but the Chief informs us that 24 hours after leaving port on her first trip the compressor broke down, and he was compelled to resort to the use of steam, which was continued on the succeeding trip. The amount of air required was far in excess of the calculated needs, and hence it was necessary to drive the compressor until it



FUEL-OIL HEATER.

gave out. The burner used here may have been responsible for the miscalculation. It seems well adapted to the use of steam, however, and is of local make, delivering a circular flame.

On this ship is an evaporator with an average capacity of 2,700 gallons of water per day, which is able to supply more than enough fresh water when clean and in good condition. The total fuel-carrying capacity is 2,400 barrels of oil, which is enough to last for the round trip from here to the Hawaiian Islands. The oil is carried in the ballast tanks in the double bottom of the ship, and from there it is pumped into two large

settling tanks, and from the settling tanks to the heater.

Originally, when air was used for atomizing, before the failure of the compressor, the fuel oil was carried one-half full in the heater and the space above charged with air at 25-pounds pressure. When it became necessary to change over to steam atomizing, the oil was allowed to carry full in the heater, and steam was admitted only at the burner at about 35 to 40 pounds per square inch.

The total fuel consumption amounts to about 100 barrels of oil per day. The steam pressure carried is 150 pounds. As a coal burner, this ship averaged 20 tons per day and logged 9 1-2 knots. Now she makes 10 1-2 knots with the above consumption of oil. As to the total economy in the use of oil fuel on this ship over cost of burning coal, the Chief figures that it will be between 30 and 40 per cent. In the fire room he has a saving of $270 per month in wages alone.

The *Mariposa* will be the next steamer of any importance to leave here with oil-burning apparatus. Her run is to Tahiti and return, about six weeks. The oil tanks in this ship are built in a part of the forward hold. Compressed-air atomizing will be used.

New Battleships.—The battleships recently authorized by Congress are to be 450 feet long on load-water line, 76 feet 10 inches extreme beam, 16,000 tons displacement, 18 knots speed.

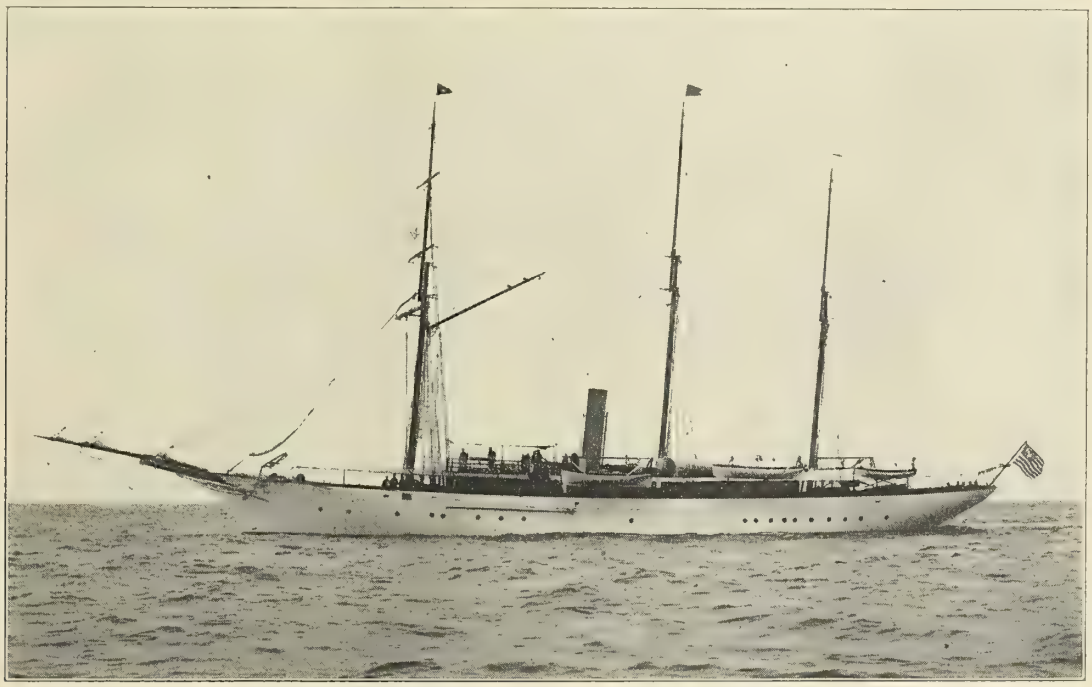
Lengthening Ships.—The new Clyde Line steamers *Apache* and *Arapahoe* are soon to be docked and lengthened 60 feet by the Messrs. Cramps. Several of the other vessels of this line have already been lengthened, and it is stated that two additional boilers will be fitted in the *Apache* and *Arapahoe*.

Roller Bearings for Marine Engines.

BY STEPHEN P. M. TASKER.

While roller or ball bearings have been used largely on small machinery and launches, their use on large marine work has been limited to a great degree. It is in just such construction that their general use will be more and more appreciated, as their advantages are better known and understood, and their defects overcome.

There is a line drawn between ball and roller bearings. The advantages of the latter have so far shown themselves that we will consider them only; besides, in most parts, it is impossible to use a ball, for the difficulty and cost of getting them true and exactly of the same size, the difference of material and hardness, their liability to crack, the grooves they are apt to wear under great pressure and the small area they cover in comparison with the roller have placed this type far behind, when we wish a practical bearing with the least wear and friction. Generally, at both ends of a bearing are the only places where balls can be used, while the roller can extend from end to end, giving all that extra bearing surface. The advantages of a ball are all covered by a roller, and except for small light work where the minimum of friction is required, the ball is at a disadvantage, although we must admit that it gives less friction. This is nothing compared to the jump from white metal or brass to roller.



STEAM YACHT SAGAMORE, FITTED WITH ROLLER THRUST BEARING.

After the results of the test to be undertaken by the British Admiralty, to determine the actual power used in running the engines and in overcoming the friction, the advantages of giving some of this power to the propeller, instead of using it up in overcoming the great friction that our modern marine engines have, will be better appreciated.

Could not rollers be easily applied to the crossheads, main bearings, crank-pins and slides? It would be easier

to insert a new roller, or new set for that matter, than to re-babbitt or take down and scrape a brass bearing. To keep a crosshead cool, and the high pressure especially, is one of the hardest nuts an engineer has to crack. With higher steam pressures the temperature rises, the load and the size of rods increase, and before we start the engine we have a hot crosshead. A bearing that heat does not affect is badly needed for both ends of the connecting rod. Rollers carefully made and tempered ought to improve this, and spare ones could be so easily applied; this applies to the slipper-face, steady bearings, etc.

Installing rollers in the crank-pins, main-bearing and crosshead, while in nature of an experiment, would be worth the trial, for there are many points in engineering gained solely by experiment.

The principal and best use to which a good roller can be put is in a thrust bearing. This was thoroughly tested in the steam yacht *Sagamore*, property of Edward C. Lee, of Philadelphia.

The *Sagamore*, being a thoroughly modern ocean-going yacht of 700 horse power, was chosen to test and compare this type of bearing. That we may be able to note the results gained solely by the addition of roller thrust, her main dimensions and particulars are added, being interesting in themselves.

The auxiliaries consist of a Sturtevant blower, feed heater, ash hopper, 300-pound ice plant with 500 sq. ft. of cooling surface for chests, evaporator, 50 gallon distiller, steering engine, one 80 volt 90 amp. electric light plant, storage batteries, donkey pump, brine pump, independent feed, two direct connected feeds, one direct connected bilge pump, one circulating pump, windlass engine and pumps for galley and water tanks.

The old horseshoe thrust gave the trouble that every engineer had to put up with, requiring a special water service pump for this only, and the quantity of oil used was considerable, besides the waste and dirt connected with it. On installing the new bearing, the pump's services were dispensed with, the oil was cut off almost entirely, the frequent adjusting needed for the old bearing was saved, and at highest turns and slowest speed there was no heating whatever, but the gain in revolutions and speed was marked with exactly the same conditions as with the old bearing. The engines turned eight revolutions more per minute and over a measured course made .7 of a knot better speed. This is a gain of 7 per cent. in revolutions, solely by a new thrust bearing of the roller type. These results should attract the attention of every yacht and steamship owner. The saving in cost of operation, the increased revolutions, and gain in speed, would more than pay for the little trouble of installation. The old body of the thrust and thrust-shaft could be used, and simply new roller horseshoes added.

It is found that true, cylindrical rollers act as well, if not better, than the tapered ones, besides having no tendency to work from the center. They require no change to the shaft collar or thrust-bearing body.

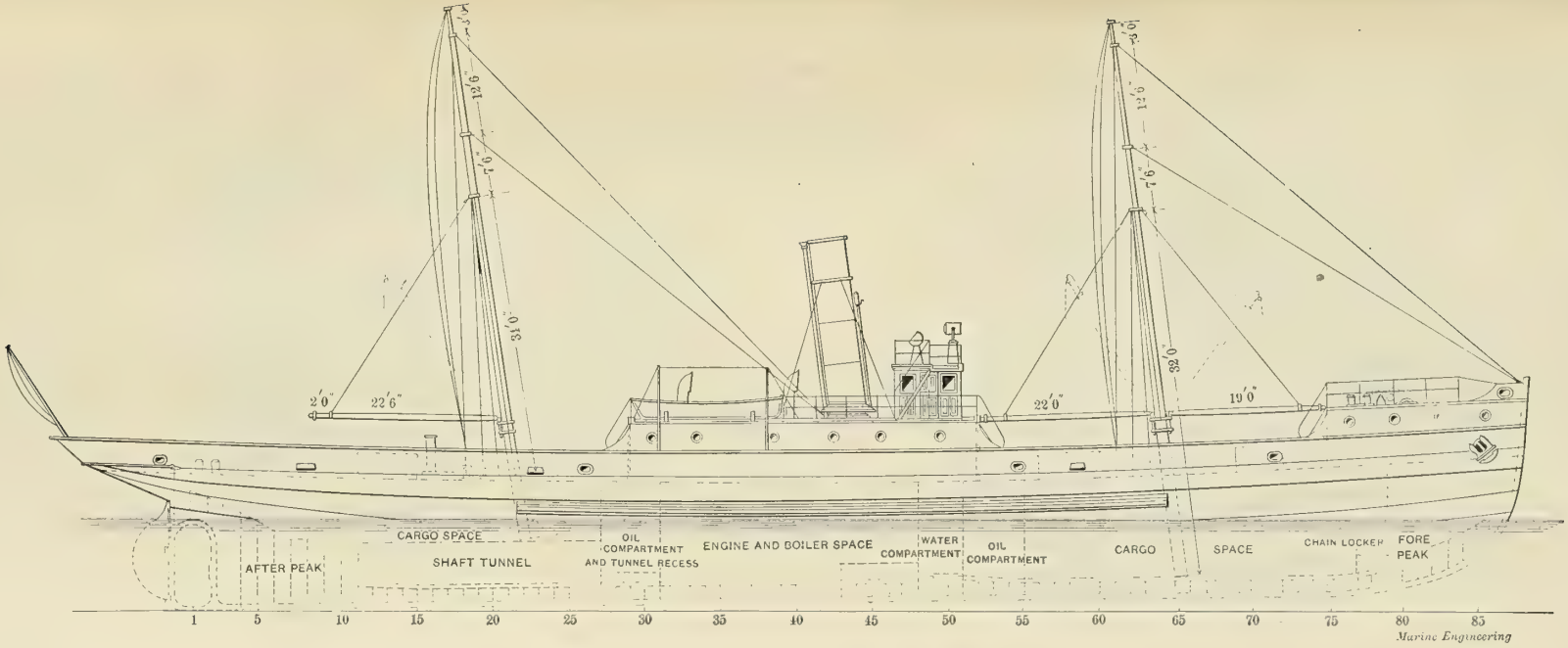
The advantages of a roller thrust have proved themselves, and if we will adapt them to the line shaft bearings and to as many other places as opportunity will allow, greater results than these will follow. An increase of from 7 to 10 per cent. in revolutions ought easily to be accomplished with a proper roller thrust, and more than this, if we will add the steady bearings, which simply take the weight of the shaft, and in doing so, use up the friction.

Before installing the new thrust under the same conditions as those of the accompanying table, the engine made 122 revolutions and 13.3 knots.

NAME—SAGAMORE — NATIONALITY—AMERICAN — TYPE—STEAM YACHT
LAUNCHED—1888 BUILDER—NEW ENGLAND SHIPBUILDING CO. OWNER—EDWARD C. LEE

Length over all	184 ft.	Admiralty coeff.	305
Length L. W. L.	160 ft.	**Boilers**, number	2 single-end Scotch
Beam	26 ft.	Pressure	160 lbs.
Draft	12 ft.	Diameter	9 ft. 6 in.
Corresponding displacement	685 tons	Length	10 ft.
Area, midship section	225 sq. ft.	G. S.	70 sq. ft.
Midship section coeff	.72	H. S.	1,700 sq. ft.
Block coeff	.48	Furnaces in each boiler	2
Wetted surface	5,000 sq. ft.	Diameter of furnaces	39 in.
Coal capacity	100 tons	H. S. ÷ G. S.	24.3
Engines, number of	1	H. S. ÷ I. H. P.	2.4
Type	3 cylinder, triple expansion	I. H. P ÷ G. S.	10.0
Cylinders, diameter	15, 24, 37½ in.	W. S. ÷ I. H. P.	.7
Stroke	30 in.	Length of Boiler Room	30 ft.
I. H. P.	700	**Propeller**	4 blades, composition
Reduced M. E. P.	32 lbs.	Diameter	8 ft. 6 in.
R. P. M.	130	Pitch	12 ft. 10½ in.
Condens. Surf.	912 sq. ft.	Developed area	24 sq. ft.
Speed	14 knots	Slip	15%
Length of engine room	16 ft.	Total weight of machinery and auxiliaries	91 tons

Admiralty Boiler Committee.—The committee appointed by the Lords' Commission of the British Admiralty to consider certain questions respecting modern types of boilers for naval purposes has at last issued its report. Therein are enumerated many disadvantages of the Bellville boiler as compared with the cylindrical boiler, and, in the judgment of the committee, the advantages possessed by this type are more than counterbalanced by the disadvantages. In the Interim report the committee advises the use of the Babcock and Wilcox, Niclausse, Durr and Yarrow water-tube types, all of which, the committee states, are free from the disadvantages of the Bellville. The Babcock and Wilcox boilers of the *Martello* are cited as having stood the test of usage very well. Besides recommending that the above boilers be used in H. M. Navy, the committee advises that the development for marine purposes of the following mentioned boilers should be carefully watched, namely, Weir, Sterling, Thornycroft-Marshall, and Thornycroft-Shultz.



FISHING STEAMER BUILT AT CRESCENT SHIPYARD.

Fishing Steamer.

A unique fishing steamer for service in Southern waters, built to the order of the Gulf Fisheries Company, is under contract at the works of the Crescent Shipyard, Elizabethport, N. J. The vessel is to be used in gathering the catch from the fishing fleet and bringing it in to the Southern markets, and on the return trip the vessel will take out stores, bait, mail, etc., to the fleet. To accomplish this work she has been designed as a very speedy craft, and is expected to make 14 knots.

The general dimensions are:

Length over all	176 ft. 3 in.
Length perpendiculars	160 ft. 0 in.
Beam, molded	24 ft. 0 in.
Depth, molded	14 ft. 0 in.
Draft	10 ft. 0 in.
Displacement	500 tons.

She is a single deck vessel with forecastle and bridge and is divided into 8 water tight compartments by transverse bulkheads. A large chain locker is in the after peak, and aft of this is the forward hold, 40 feet long, and with a capacity of 8,000 cubic feet. Aft of this is a transverse oil tank 7 feet long, extending the breadth of the ship. Next comes the deep well 5 feet 6 inches long, in a fore-and-aft direction. The boiler and engine room are in one compartment 30 feet 6 inches long. Aft of this is the second oil tank extending the breadth of the vessel and 7 feet long. The after hold runs from this tank 36 feet 6 inches to the after bulkhead, and contains 4,050 cubic feet. The forward and after holds will be used for carrying the cargo of fish either in bulk or in crates.

One of the novel features of this vessel will be the equipment of boilers with oil burners, 70 tons of fuel oil being carried in the two oil tanks above mentioned. The water tank will carry 30 tons of water.

The crew's quarters are in the forecastle, and the officers and engineers have separate and commodious cabins in the bridge house.

The ship is built with a bar keel, and is of steel throughout, except part of the deck plating over the holds. She will have two masts with two derricks on the foremast and one on the main, and at each mast will be located a cargo winch. There is a windlass in the forecastle which operates the capstan on the deck above.

There will be water tube boilers of 80 square feet of grate surface furnishing steam at 250 pounds pressure. The engine is of the triple expansion inverted direct acting surface condensing type, with cylinders 14, 22 and 36 inches in diameter by 24 inches stroke, and when running at 210 revolutions will develop 1,000 I. H. P. The cylinders are supported by four wrought columns at the front, and at the rear are cast iron frames into which is built the condenser. The circulating pump will be direct connected, 20 inches in diameter by 12 inches stroke.

The construction and equipment of this vessel will be of high class, and she will be built more on the lines of a yacht than those of the accustomed form of fishing vessel. This fact will be appreciated when it is stated that her block coefficient of fineness is but .48.

ELECTRIC IGNITION.—II.

BY DONALD M. BLISS.

The great advantage of the magneto type of igniter is in its permanent magnetic field, and the consequent ability to furnish a working current at comparatively low speed. It may also be run in either direction without any change in connections, so that when a reversing engine is used it is the only type of generator suitable for such a case.

The practical speed limit in a certain well-known make is from 600 to 3,000 or 4,000 revolutions a minute, a satisfactory spark being furnished within these wide limits. As the voltage, however, increases with the speed, there is danger of too heavy a current at high speed. The contacts deteriorate rapidly under these conditions. The best practice is to arrange the driving gear so that the average speed does not exceed 2,000 R. P. M.; in this way, if the engine has a normal speed of 300 R. P. M., it may be run as slowly as 125 R. P. M. and the magneto will still furnish a satisfactory spark. A well-made magneto igniter will stand a temporary increase of speed to 4,000 or 5,000 R. P. M. without injury. The writer knows of more than one case where a maximum speed was as high as 6,000 R. P. M. Under such conditions, however, the owner naturally wondered why the cylinder contacts required such frequent renewals.

The best method of driving these machines is by means of a properly arranged friction pulley running against the face of the engine flywheel. In the endeavor to secure constant speed, friction pulleys have been arranged with a governor device operated so as to vary the contact of the magneto pulley with the engine flywheel, so that a fairly constant speed is secured for the magneto, even if the engine speed varies widely.

These automatic devices operate on the principle of a centrifugal engine governor, and, while they are in quite extensive use, there are a number of joints and working parts necessary which introduce additional complications without securing corresponding benefit; for a good magneto generator, as stated above, should operate between widely varying speeds with good results.

A good friction pulley properly adjusted to a true-running flywheel is decidedly preferable to driving by a belt. If the latter method is used a flat belt is desirable, and the machine should be invariably provided with a sliding base or other similar device to allow of quick adjustment. Where the friction pulley is used it is necessary that the flywheel run truly, otherwise rapid deterioration will occur from springing of the armature shaft or rapid grinding away of the outer surface of the friction pulley.

It is also important to note that oil of any sort will quickly destroy rubber. Fiber friction pulleys are used quite extensively, and give good satisfaction when carefully adjusted and attended to. I believe, however, that in unskilled hands, and under the conditions that usually obtain in marine work, the rubber-covered friction pulley will be found most satisfactory.

Figs. 1 and 2 show representative types of magneto igniters. These two makes are now widely used and are coming rapidly into favor for marine work. They are, of course, designed on the same general lines, differing from each other only in mechanical details and arrangement of parts.

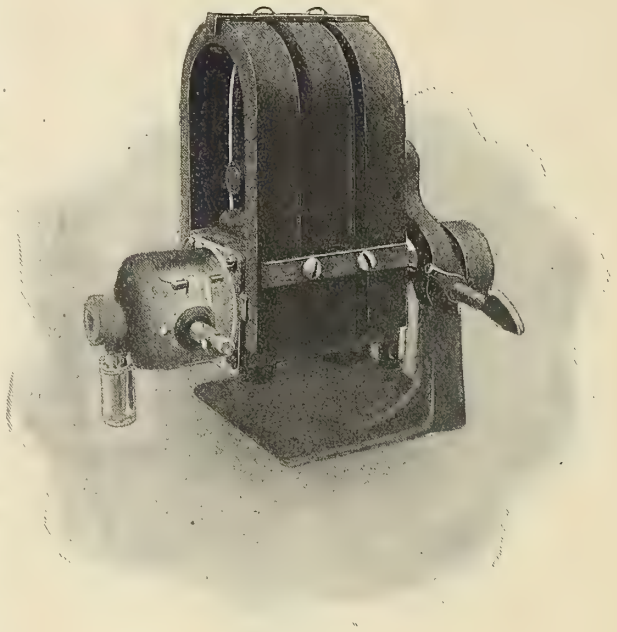


FIG. 1.

The magneto shown in Fig. 1 has the usual heavy, permanent magnet field with soft-iron pole pieces. The armature is laminated, slotted, and wound in a

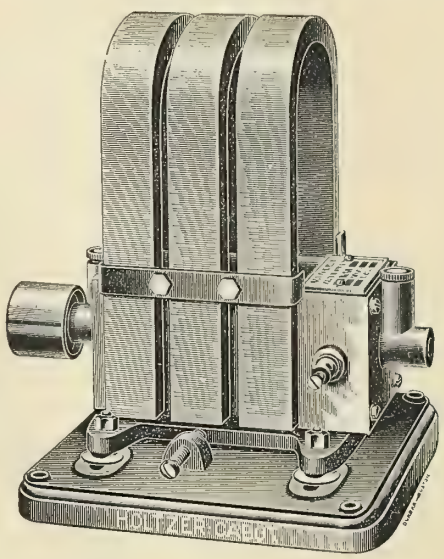


FIG. 2.

similar manner to the ordinary direct-current dynamo or motor. The commutator is of copper, and carbon brushes are used, so there is very little wear at this point. The distinctive feature of this magneto is a supporting and adjusting device. The machine is mounted on a strong pin on which it rocks. This permits of the belt being tightened if it becomes loose, or

the friction pulley adjusted by means of a thumbscrew provided for the purpose. The square base or pedestal is fastened to the floor or to a suitable shelf, and the adjusting screw inserted in the side toward the engine (in the case of a belt drive). This allows the igniter to be pushed away from the engine pulley so as to tighten the belt as it becomes loose. When it is desired to run the magneto by a friction pulley a spring can be attached to the bottom of the machine so as to draw it toward the flywheel, thus securing a good automatic adjustment and practically constant tension as the pulley wears away.

It will be noted that the armature, with commutator, is completely encased so that it is waterproof. It may be run in either direction, and is therefore well adapted to two-cycle marine motors which are often reversed for backing the boat. It is fitted with automatic bottom-feed oil cups. These are provided with a spring and wick device, thus ensuring perfect lubrication. One filling of oil will last three or four weeks. The manufacturers do not claim that this machine is adapted for jump-spark work, but it gives good results in the wiping-contact system.

The machine shown in Fig. 2 is very widely used, and differs from the above in the following features:

The lubrication is effected by means of grease cups, and the lubricant used is the well-known Albany Compound, No. 2 Grade. The cups are provided with a loose pin, which reaches through the bearing and rests lightly against the shaft. The grease gradually feeds down the pin, and one filling of the cups should last two or three months.

The distinctive features claimed by the manufacturers of this machine are the powerful field, the armature wound with double silk-covered wire, and mica insulated copper commutator, securing a high insulation, and extra large square brushes. These are made of carbon with soft copper gauze embedded within, thus securing high conductivity with the good wearing and lubricating qualities of the carbon.

The belt-tightening or adjusting device, as shown, consists of double adjusting and clamping screws, by means of which the igniter may be moved in either direction on its base and securely clamped in position.

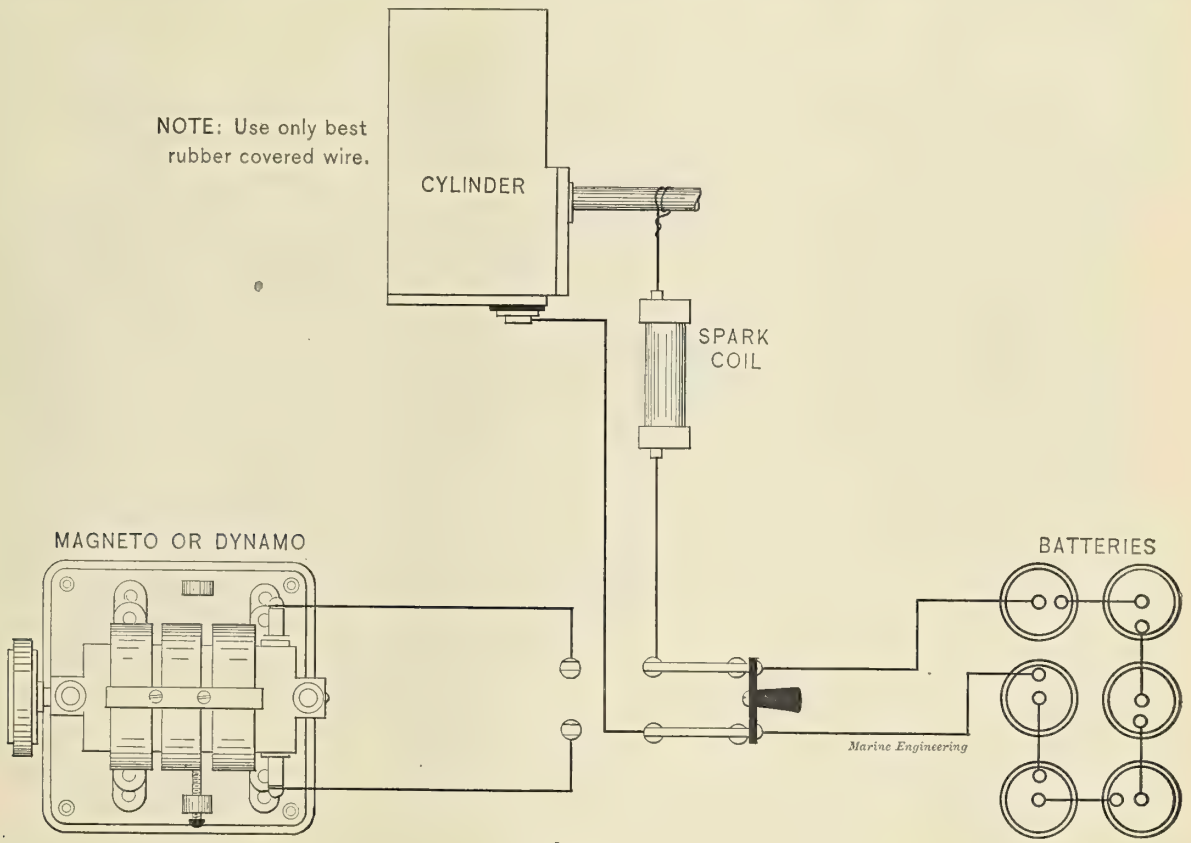


FIG. 3.

The manufacturers are supplying these machines in certain sizes for jump-spark work with satisfactory results.

Fig. 3 shows a diagram of connections in which a few cells of dry battery are connected through a switch in such a manner that they may be used for starting the engine only; after it is up to speed the switch is thrown over to the igniter connections and the battery disconnected.

As stated in the previous article, good insulation is most important for successful operation in marine work. The wiring, switches, and other fittings should be of the best and most substantial construction, and high insulation maintained. For making the various connections the best quality of rubber-covered, stranded conductor should be used, not smaller than No. 12

B. and S. gage, owing to the ever-present vibration on the motor boat. A solid or single wire conductor is very liable to crystalize and break off where it is connected to the various binding posts, and, with the usual perversity of electrical devices, these breaks generally take place in concealed or inaccessible places.

It is not advisable to use the small wood-base button and lever switches usually offered by the dealer. Instead of these a small, porcelain base, double-pole, jackknife switch should be insisted upon.

While the spark coil and batteries may be placed under the seats or in some convenient locker, the switch should be placed in plain sight and within reach from the engine, so that when running at slow speeds, or for general manœuvering, it can be seen at a glance whether the engine is running from the battery or igniter, and the switch can be immediately operated without having to leave the engine. Automatic switches are now on the market, so arranged that as the engine reaches its normal speed the battery will be automatically disconnected and the igniter will be thrown in circuit. These switches are convenient, but as they are encased, and are not provided with an indicator, it is not possible to tell in cases of emergency whether the connections are on the battery or on the machine.

In making the various connections the wires should be carried under porcelain cleats or through well-insulated tubing; and where they are secured to the various binding posts, a few turns or spirals should invariably be made, so as to allow some slack wire for reconnecting in case the wire breaks off at the binding posts.

For multi-cylinder, high-speed engines it is not advisable to use the old-style long spark coils, owing to the time required for charging and discharging. Short, high-speed coils are now on the market at low price for that purpose.

Nine-tenths of the trouble experienced with magneto igniters is due to imperfect contact of the brushes with the commutator. This may be caused by a poor grade of carbon, or dirty commutator, or too weak a spring of the brush holder.

The front bearing cap of the igniter or the cover over the commutator should be removed every week or so and the commutator cleaned with a little gasoline, and if there are any signs of burning or blackening it must be repolished with fine sandpaper. A little attention to this matter of cleaning will usually save many vexatious interruptions in service.

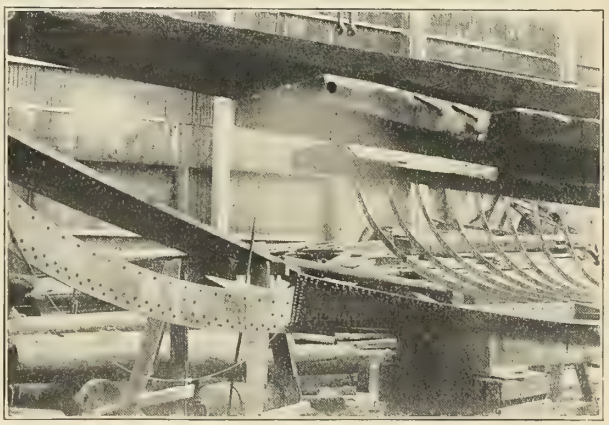
Under no circumstances should the armature be removed from the machine without first placing a heavy soft-iron plate or keeper across the bottom or poles of the magneto. If the armature is taken out without observing this precaution, the strength of the field magnets will be seriously reduced and the igniter will be put out of commission. In case this accident should happen, it will be found necessary to have the armature thoroughly remagnetized before it can be used again.

Electric Launch.—The Bureau of Construction and Repair are testing an electric launch made in the New York Navy Yard with a view of using this type of vessel for warships.

STEEL TOWBOAT VESTA FOR THE MONONGAHELA RIVER.

A steel-hull, stern-wheel towboat was recently launched from the ways of James Rees and Sons Company, Pittsburg, Pa. The boat was built under the supervision of Capt. Warren Elsey for the Vesta Coal Company, mainly for towing coal from the mines situated along the upper pools of the Monongahela river to the mills and furnaces of the Jones and Laughlin Company, Limited, at Pittsburg. Her length of hull from stem to after transom measures 135 feet. and over all, including wheel, 156 feet 6 inches; breadth, molded, 23 feet 4 inches, over nosing 24 feet 1 inch, with a depth of hold at frame No. 40 of 4 feet 6 inches. The sheer forward is 2 feet 10 inches, and aft 1 foot 9 1-2 inches, with a 6-inch crown of deck.

The transverse frames are of 3 by 2 1-2 inches, 6 1-2-pound angles placed 18 inches apart, carried up to top of gunwale, and composed of a short and long piece, the joints being 2 1-2 feet inboard from knuckle and alternating between frame and side of boat. The deck



VIEW OF STEM AND KEEL PLATE.

beams are 2 1-2 by 2 1-2, 5-pound angles spaced 3 feet, coming upon every other frame and fastened thereto with gussets. One of the accompanying pictures shows the stem, near the after end, slotted to receive the plating, and from there forward the plates are flanged and riveted as usual to sides. This arrangement is original with this company, also the boxes used along the bottom of bulkheads. The stern post is 2 inches thick by 8 1-2 inches wide at top and 5 1-2 inches at bottom. The radius of knuckles is 12 inches, and between them and the modeled bow and stern there is a dead flat. The thickness of hull plating is 5-16 inch on bottom, knuckles 3-8 inch, bow 1-4 inch, sides 7-32 inch, and decking of 2 1-2-inch white pine. The longitudinal seams and transverse joints are all double machine riveted. There are 5 cross and 3 longitudinal water-tight bulkheads of 3-16-inch plate, well stiffened with vertical angles extending from the deck beams to the frames. A stringer of 2 1-2 by 2 1-2-inch angles extends along at top, under the beams, for the full length of boat. At the bottom the bulkheads are made water-tight by means of the boxes placed between the frames and on the side opposite the vertical stiffeners. These boxes are made of plates flanged

on the lower side and at the ends, thoroughly riveted to bulkhead, frames, and bottom plating. A breast hook is placed at the bow, extending from stem to forward bulkhead and attached to the frames by gussets. Between the center and wing bulkheads there is a keelson of 3-inch Z-bar extending from the forward bulkhead to the main transom, secured to each frame by an angle-iron clip and to every deck beam by an angle-iron stanchion of 2 1-2 by 2 1-2 by 5-16-inch section. To stiffen the boat under the boilers, one of the cross bulkheads is placed at the forward end and another at the after end of boiler, properly reinforced with angles resting along the frame, while extra beams are placed on each side of the cross bulkhead supporting boiler sills.

As is the case in these hulls of shallow depth, two hog chains—one on each side of the boat—of 1 1-2-inch round iron extend from under forward end of boiler to stern over braces of 8-inch iron pipe. The ends of the chains are securely fastened to bottom of hull. This is somewhat of a departure from the usual custom, as white pine braces are generally used, but cannot be so serviceable in case of fire.

Occasionally—and it may be said, seldom with success, unless light duty is required—river steamers are built without hog chains, it being considered that the fore and aft bulkheads will keep the hull from "hogging." Even with chains, great care must be taken in the distribution of the weights. The usual tendency is for the boat to come up amidships, and to overcome this relief chains are so placed that the braces rest upon this part, with the ends of the chains taking hold under the main braces. The relief chain braces extend fore and aft only a short distance, and the tops of the braces go on higher than the under side of the boiler deck.

Three rudders are provided, the central one being balanced, or nearly so, the forward half being shaped to conform to the rake of the boat. In order to prevent drift and ice from getting between the rudder and the bottom of the boat, the latter is so curved that the rudder remains close in its full swing, which is about 45 degrees. The old wooden boats accomplished the same thing by having the bottom bustled out over the planking as the case required. So as to work uniformly, the two outside wing rudders are hinged to the skeg stern posts by means of heavy clevised hinges, having a long pinbolt running through the hinges and attached to the central one by a connecting bar. The rudder stocks are formed of 10-inch XX lap-welded tubing, having their sides flattened to receive the rudder plates, which are composed of two 1-4-inch plates laminated and reinforced with longitudinal stiffeners composed of 3 1-2-inch T-rails, closely riveted through the plates.

STEEL TOWBOAT VESTA, BUILT BY JAMES REES AND SONS COMPANY.

The cylinder beams are of an I-beam pattern and made of 1-2 by 26-inch web plate at the deepest place, and having a catenary curve reduction at the after end to 13 inches, having 8 by 5-8-inch top plates supported by 3 1-2 by 4-inch 9-pound angles, top and bottom, closely riveted. The shaft is of hexagonal section, 10 1-2 inches diameter, with 10 1-2 by 8 1-2-inch journals, and the cranks are shrunk and keyed on the shaft at 90 degrees. The cranks are 4 1-2 inches, tapered, bored for the wrists, and are also shrunk on from the inside.

The shaft carries four 48-inch steel wheel flanges, having pockets for thirteen 3 by 6-inch arms. The

flanges are first assembled in position by keying with wooden wedges on the flats of the hexagonal shaft. When all are in perfect alignment the wooden wedges are displaced by driving in iron wedges, thereby completing the mounting of the flanges on the shaft. The wheel, complete, is 19 1-2 feet diameter by 16 feet long, having 30-inch width of buckets, 1 1-2 inches thick.

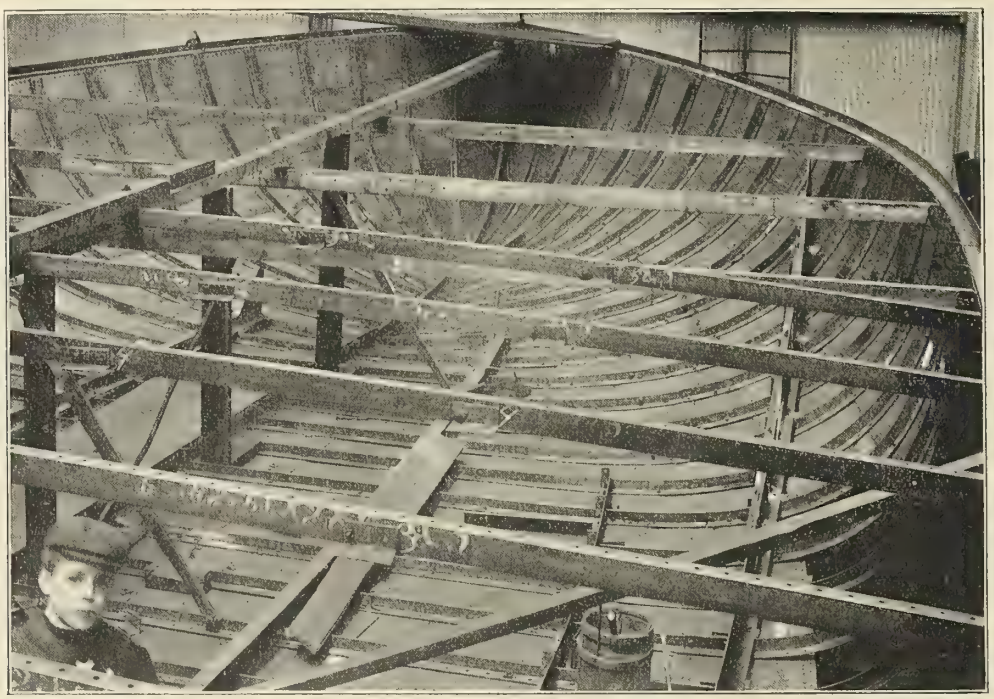
The engines are 400 I. H. P. tandem compound condensing, having one pair of engines on each side of the boat, with cranks connected at right angles. The high-pressure cylinder is placed forward of the low-pressure, mounted on the steel cylinder beams, the high-pressure cylinder being securely attached to the low-pressure by means of a separator and extending forward without any rigid support, but carried, by the flange bolts and equalizing springs, under the center of the same.

The dimensions of the cylinders are 12 inches diameter for the high-pressure and 24 inches for the low-pressure, by 6-foot stroke, the areas being in a ratio of 1 to 4. The steam is received at the center of the connecting pipe leading to the valve chamber, at which point it is controlled by a plunger valve, loosely attached to a button-head stem, reaching through a gland at the base of the housing frame and connecting a triphead carrying a swinging dog, lifted by a right-angle swinging lever in connection with the center arm at the center of the cylinder, which is given motion from the rock shaft. This motion is transmitted from a modern parallel motion taken from the pitman direct (not shown in the drawing), thus requiring no cam frames or eccentrics. The exhaust ports are controlled by a piston valve independent of the steam valve, as shown on the drawing. The cut-off motion is transmitted from a swinging pendulum trunnioned at the top of the column, supported by the slide of the engine, having an arm attached to a horizontal shaft at the top of the column. This shaft is pinned to a swinging pendulum, which is given motion through a thimble on the crosshead, giving variable graduations from 1-4 to full stroke of the engines. The cut-off is controlled by a system of shafts and levers leading to a pulpit quadrant, within the reach and control of the engineer at the throttle.

The piston heads are of the conventional type, having bull and snap ring, made of Homeo iron or semi-steel, a very superior material for the purpose. The piston rods are made of forged nickel steel, 4 inches diameter for the low-pressure cylinder and 3 inches for the high-pressure cylinder, all fitted with metallic packing. The large piston head is keyed to the rod, while the small head is forced upon a standard taper and held by a heavy and finely-threaded nut. The cylinder heads are designed to conform to the shape of the pistons, allowing about 4 1-2 per cent. clearance space. The shipping-up apparatus consists of two independent trunning cylinders, one on each side of the boat, mounted above and attached to the reversing forks, supported above by a tripod frame. The steam is received at the cylinder through the trunnion on one side, and exhausted through the trunnion on the opposite side. Trunnions accommodate the required radial motions and at the same time facilitate the pipe connections through the stuffing boxes.

The operating valve of the shipping-up apparatus consists of a four-way rotary valve, permitting the independent shipping of the engine, thereby enabling the engineer to lock his engine against the vacuum pressure when stops are made.

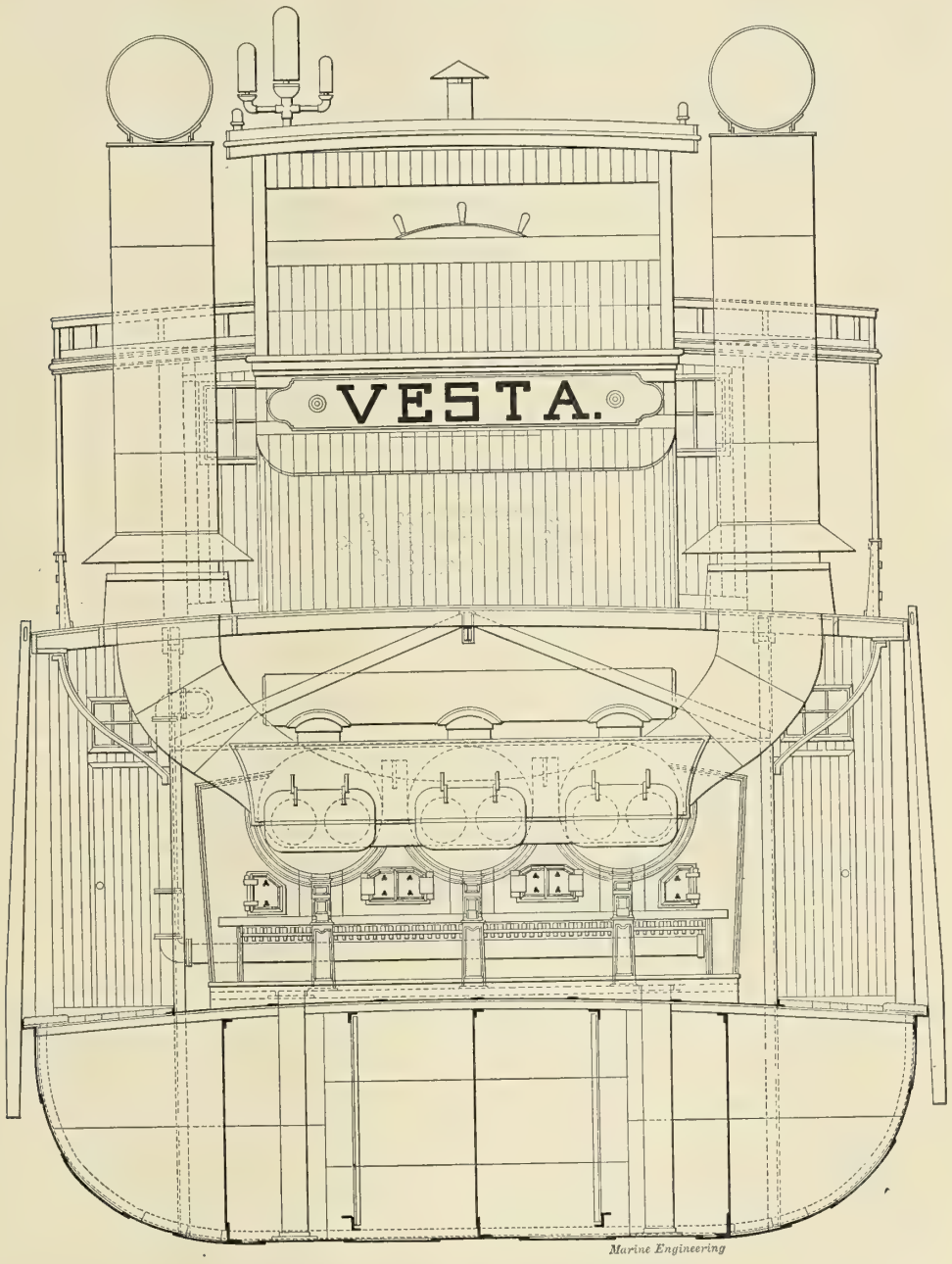
The condenser is of the surface Admiralty type, and is of the Wheeler Engineering Company's make, having



VIEW OF BOW OF TOWBOAT VESTA, SHOWING CONSTRUCTION.

600 5-8-inch tubes, giving 800 square feet of cooling surface. The dimensions are 2 feet 3 inches by 8 inches in length, mounted on cast-iron frames 24 feet high and securely attached by bolts to the deck. It is situated on the center of the deck over deck beams connected to the condenser by a 6-inch line, discharging into the hot well through a 3-inch line and maintaining quite a uniform vacuum of 26 inches.

The boat is also provided with a "nigger," a "doctor," and a "donkey."



SECTION THROUGH BOILER ROOM, STEEL TOWBOAT VESTA.

Nos. 56 and 58, and is supplied by a circulating pump, also of the Wheeler pattern, 8 by 14 by 12 inches, taking supply through two 7-inch suction lines leading from hull side about midships, with 34 inches diameter cylindrical well from whence the pump is supplied, and discharged through an 8-inch line to the condenser.

The air pump is also of the Wheeler pattern, 8 by 12 by 12 inches, situated on the port side of the hot well,

The "doctor" is a familiar name given to the boiler feed pump, and needs but little description here; however, it may be well to state that it is a Rees standard No. 3 doctor pump, having a capacity of 1,680 gallons per hour at a nominal speed of 15 revolutions.

The "donkey" is, likewise, a name given to a hand pump, consisting of two vertical barrels fitted with plungers and operated by means of a walking beam to

receive hand levers, and generally used for the purpose of washing the decks or the boilers when in course of cleaning them.

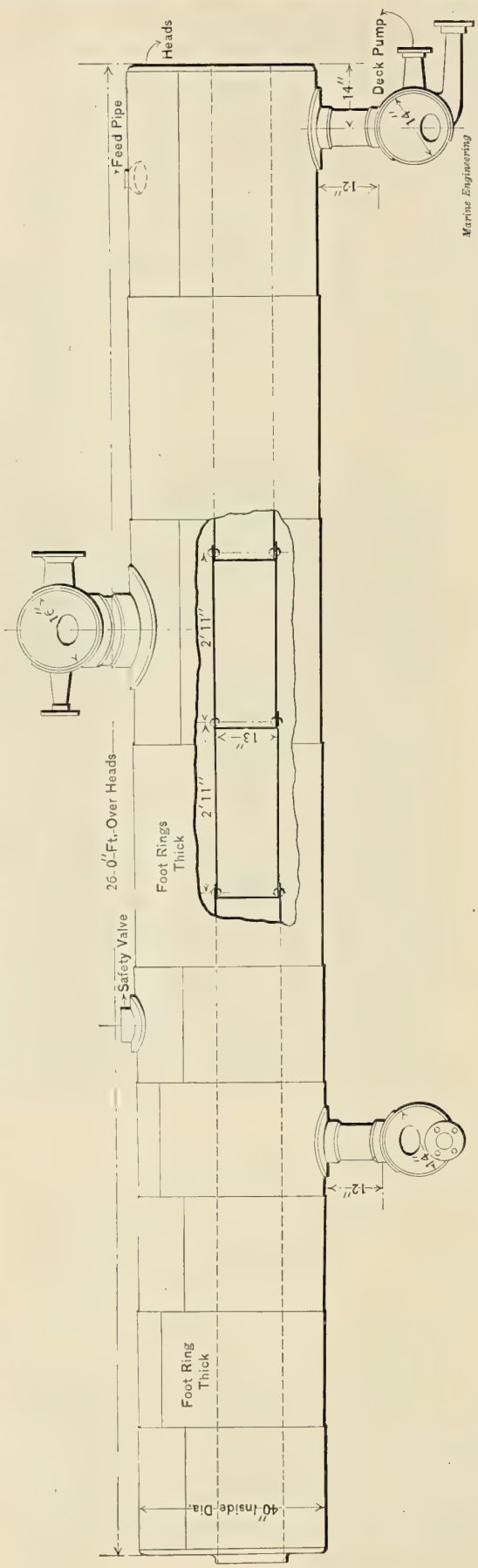
The "nigger," or capstan engine, is mounted on an A-frame constructed of 5 by 14-inch timber, standing 'thwartships on the port side and directly abaft the forecastle bulkhead on the main deck. It has a vertical shaft connected by a bevel gear, a similar horizontal shaft connecting the capstan under the main deck at the bow of the boat.

The "nigger in a box" is a type of small oscillating capstan engine mounted in a rectangular cast-iron box, standing about 12 inches high, operating a small winch barrel on top of the box by means of a worm and gear connection. One of these is placed on each side of the boilers, and they are used for drawing up the barge lines when making up tows.

The light plant consists of one Westinghouse direct-connected 17 1-2 K. W. multipolar, shunt-wound generator, with a Westinghouse engine having a capacity of 110 16 C. P. incandescent lamps throughout the boat, with two arc lamps on each side of the boat at the stern, and an 1,800 C. P. reflector headlight located on the forward boiler deck. This plant is situated forward of the condenser, or aft of the cross bulkhead at the deck room division. The engine is supplied with steam from the auxiliary steam line, having a Mason reducing valve, reducing the steam from 181 to 90 pounds pressure.

The boilers are of the conventional Western river marine two-flue type, with a shell thickness of .28 inch, 65,000 T. S. marine steel, and arranged in a battery of three, 40 inches diameter by 28 feet in length, and with two 13 1-2-inch flues running full length of each. The steam drum is 16 inches diameter by 10 feet 6 inches in length, supported by 13 1-2-inch legs, standing 8 inches above the boiler shell, flanged and double riveted through the shell, carrying on the inside a steel muzzle to provide against liability of the gage float entering the steam drum and closing up the openings. The boiler is designed throughout under the marine laws to carry a gage pressure of 181 pounds.

The boilers are supported at the after end by a 14-inch-diameter pipe, running horizontal and cross-connecting each boiler by 7-inch-diameter leg by 13 inches high, the whole resting on three cast-iron stands securely attached to an 8 by 12-inch steel-plate boiler sill. There is also a 4-inch-diameter mud drum extending across under the boilers and connecting each in a similar manner as the stand pipe. This drum, however, has no supports on the boiler deck, thus providing for expansion and contraction of the boilers. The forward ends of the boilers rest on a heavy cast-iron front set in a steel water-tight ash pan extending forward of the boilers and furnishing an ash chute connecting two 10-inch wells running directly through the hull of the boat, through which the ashes from the furnace are forced into the river by means of a 6-inch overflow line leading from the condenser. This line is also provided with an automatic valve, connecting and leading to a 1,300-gallon reserve tank placed at a short distance abaft the end of the boilers. The 16-inch steam drum referred to is provided with four steam line nozzles, as follows: Main steam, 5 inches; auxili-

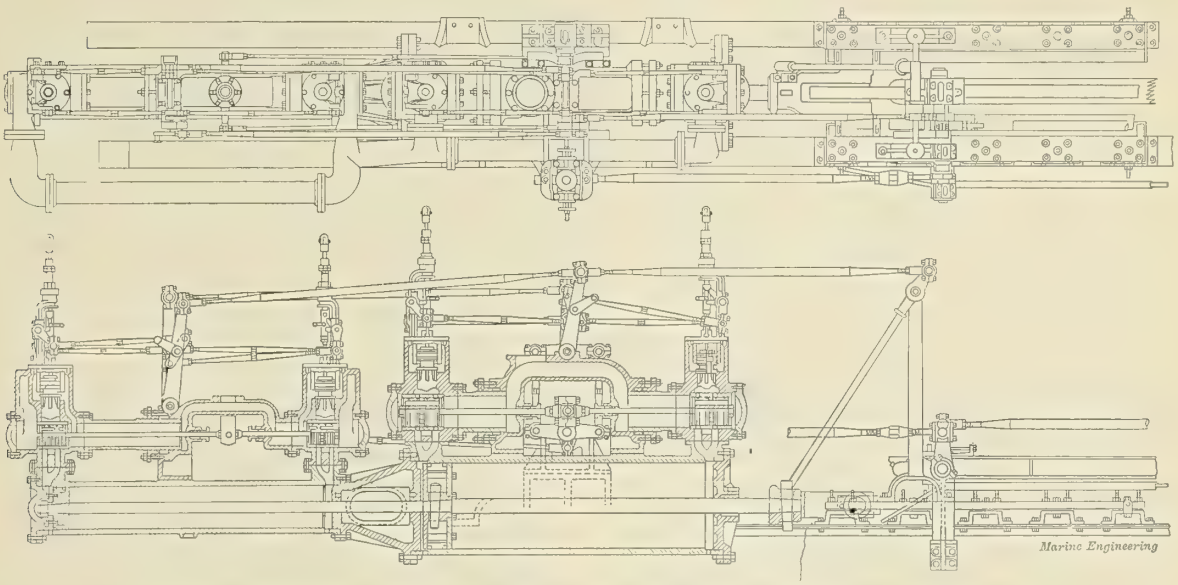


TWO-FLUE TYPE BOILER OF THE TOWBOAT VESTA.

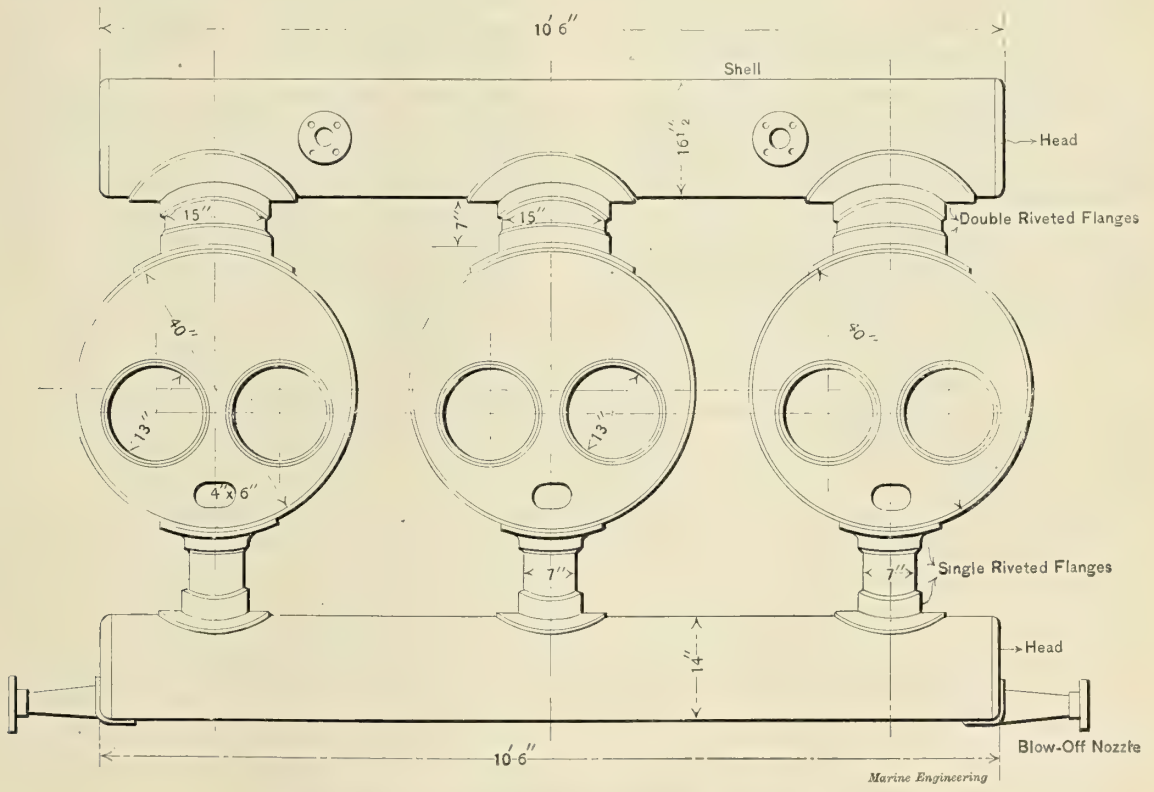
ary, 3 inches; and two 2 1-2 inches for capstan and siphon work.

The boilers give a total heating surface of 1,156 square feet, with a grate surface of 50 square feet, giving a ratio of 2.89 I. H. P. per square foot of heating surface. The coal consumption has been computed at about 19,000 pounds of run-of-the-mine coal each 24 hours, or 1.98 pounds per H. P. hour.

The rudders are operated by means of a steam steering gear having cylinders mounted upon an elevated frame at the after end of the boilers on the main deck, and are controlled by the pilot by means of a valve situated within his command.



PLAN AND SECTION OF ONE OF THE TWO COMPOUND ENGINES OF THE VESTA SHOWING VALVE GEAR.



ELEVATION OF REAR END OF THE BOILERS ON THE VESTA.

The width and height of towboats used in the two local rivers are necessarily narrower and lower than those of the Ohio, Mississippi, and many of their

tributaries. The large locks are 56 feet by 250 feet, and the smaller size 50 by 190 feet, and, to facilitate locking fleets through, the towboats are usually not made wider than the one in question. A barge may then be taken alongside through the small lock, if necessary. The draft, being increased by narrowing the boat, sometimes becomes a serious matter when the unimproved parts of the Ohio or Allegheny are navigated, and frequently this is made impossible during the low-water period.

The *Vesta,* heavily loaded as she is with compound engines, condensers, etc., draws 4 feet at the bow and 3 feet 6 inches at the stern when full coaled. Although it is considered that this boat is built unusually strong, she draws no more than other boats of wooden hull and same size in this district. This is due largely to the experience of the builders, the weight of the material being no greater than absolutely necessary. Some of the packets of greater beam do not draw more than 20 to 30 inches, particularly those navigating rivers or parts of rivers not slack-watered. To carry the weights imposed upon them, these stern-wheel boats are given full lines aft, which, by the way, are not conducive to speed. The *Vesta,* however, can make 10 to 12 miles per hour in the slackwater pools. The lines of this boat are similar to those of the stern-wheel steamers *Juniata* and *Braddock,* built by this company a short time since. The hulls of the latter boats were of wood. In the designing of these boats speed becomes a secondary consideration, power and light draft being the paramount requirements. With a nominal tow of five barges of coal containing 2,600 tons, or 65,000 bushels, however, the towing capacity of the boat is about 4,000 tons of barge coal. As to height, the *Vesta* is made to suit the conditions of the local rivers. Between main deck and boiler deck she is 10 feet, and between boiler deck and top of pilot house, 13 feet; to top of pilot house above water line she is 27 feet 6 inches, and at this height the stack is arranged for lowering by a winch. Most of the bridges on the Monongahela have not less than 50 feet clearance above the slack-water pools, but with a rise of 10 to 12 feet (beyond which little navigation is accomplished) some of the bridges in the Allegheny are not more than 30 to 35 feet above low water, and the necessity for low-built towboats is thus easily seen.

On the main deck forward is the coal bunker, with a capacity of about 1,000 bushels. Immediately aft of this is the boiler room, with a length of 48 feet; then comes the engine room, 62 feet long. The main deck house has a width of 24 feet.

In the cabin, beginning aft of the pilot house, there are 6 rooms for officers, each being in size 8 feet by 6 feet 3 inches, with 2 bunks each; then comes the mess room, and to this point there is a central passageway. Aft of the mess room are the kitchen, pantry, linen closet, bath room, sitting room, ice chest, and three rooms for the crew.

This firm has made numerous boats for South America, some for Mexico, and recently one was sent to China, the hull parts being carefully fitted together, then taken apart for shipment across continent and ocean. The boats built for Mexico were staunch enough to steam their own way across the Gulf of Mexico, after having passed the long distance down the Ohio and Mississippi rivers.

Not long ago a steel-hull boat for navigating the upper Yukon river of Alaska, of somewhat smaller dimensions, but in general design quite similar to the boats just described, was erected in the yards at Pittsburg, Pa., in material form, but in temporary or knock-down shape. All plates, frames, beams, stanchions, and other parts were carefully numbered and registered one with the other, thus providing for and expediting the re-assembling of the parts at the final destination. All the parts were bundled in light and compact form for shipment by rail to Seattle, Wash., thence by water to Skagway, where the entire cargo was transferred to small cars of the Yukon and White Pass Railway, which succeeded in delivering the material to White Pass, after many mishaps and delays, this being the end of rail transportation at that time. From White Pass it became necessary to transport, by means of pack mules and dog sleds, the whole cargo a distance of 39 miles over the ice and snow-covered mountains of Alaska to Lake Bennett, the final destination, and during the month of February, at a time when the mercury registered about 20 degrees below zero. The party encountered much suffering during some three weeks of this form of transportation from the end of the railroad to the destination at Lake Bennett. Finally, logways for the hull were laid on the beach at Lake Bennett, upon solid ice, after removing 5 to 7 feet of snow, and the work of reconstruction was begun by a force of skilled workmen under the supervision of Capt. P. Y. Ingaldsby and John Tarn. The boat was launched with boilers, machinery, and all outfit aboard within 35 days from the time of arrival of material. Her maiden trip was made over the lake through running ice, under the guidance of an Indian pilot, passing down through the White Horse rapids with safety, a feat, possibly, never before successfully accomplished by a steamboat of her dimensions. After passing through the rapids, her route was down the Upper Yukon river, loaded with passengers and general merchandise for Dawson City and the Klondike, returning with passengers and gold shipments.

Lake Superior Commerce.—All monthly records for freight tonnage through the Lake Superior canals were broken in July, when 5,082,298 tons were transported through this waterway.

Oil Fuel.—The Red Star Line steamship *Philadelphia* is at the yard of the Wallsend Shipway and Engine Company on the Tyne, England, where she is being fitted with oil-burning apparatus. If this system proves successful and economical, it is stated that the owners will adopt it in other vessels on their line.

Steamship Kaiser Wilhelm II.—On August 12 the longest steamship in the world, *Kaiser Wilhelm II.,* built for the North German Lloyd Steamship Company, was launched from the Vulcan shipyard, Stettin, Germany. The over-all length is 707 feet; beam, 71 1-2 feet 6 inches; depth, 39 feet; draft, 29 feet. The vessel is to be propelled by engines developing 39,000 horse power, which it is expected will give the ship the speed of 24 knots.

GAS ENGINES AND THEIR TROUBLES.—IV.

BY E. W. ROBERTS.

Gasoline.

Although widely employed as a fuel for heat, light, and power purposes, gasoline is a substance the properties of which are not generally understood. Quite a number class it with explosives such as gunpowder and nitroglycerine, while in point of fact gasoline alone is not in the slightest degree explosive. To secure an explosion in a gasoline engine, or anywhere else in fact, by the use of gasoline, it is necessary to have present a certain proportion of air. This is but one of the superstitions about this fuel which the writer hopes to dissipate.

To start at the beginning: Gasoline is the product of petroleum midway between benzine and kerosene, or rather it consists of a series which, in the selective distillation of petroleum, is obtained after the benzine

FIG. 18.

has been evaporated and before kerosene commences to be distilled. In the oil trade it is known as naphtha, being divided into three grades, A naphtha, B naphtha, and C naphtha, A naphtha being that last given off and hence having the greatest specific gravity. By the retail trade it is generally known as gasoline, and is sold according to its specific gravity, which is designated by so many degrees on an arbitrary scale known as Baume's scale. Stove gasoline having a specific gravity of 72 degrees Baume is that generally employed for gasoline engines, although gasolines from 66 degrees to 76 degrees may be used with success when employed with a vaporizer.

Petroleum and all the products derived therefrom belong to a family of chemical compounds known as hydrocarbons. The name comes from the elements hydrogen and carbon, of which there are a large number of different combinations. These vary from a light gas, as methane or marsh gas containing one atom of carbon and four atoms of hydrogen, down through heavier gases and then through a long series of liquids, starting with the petroleum ethers and ending with the heavier machinery oils. Following these come vaseline and the solids such as paraffine and finally coke.

Varying proportions of the two elements give substances having different physical properties. Naturally the greater the proportion of hydrogen, the less the density of the hydrocarbon. Quite frequently hydrocarbons having the same proportions precisely of the two constituents show different physical properties.

The origin of petroleum is interesting, particularly as the popular belief attributes it to the same source as coal. The latest investigations, however, point to an animal origin. In prehistoric times convulsions of the earth's surface caused the burial of large quantities of sea animals, principally of the mollusca. Disintegration followed without the presence of oxygen, the

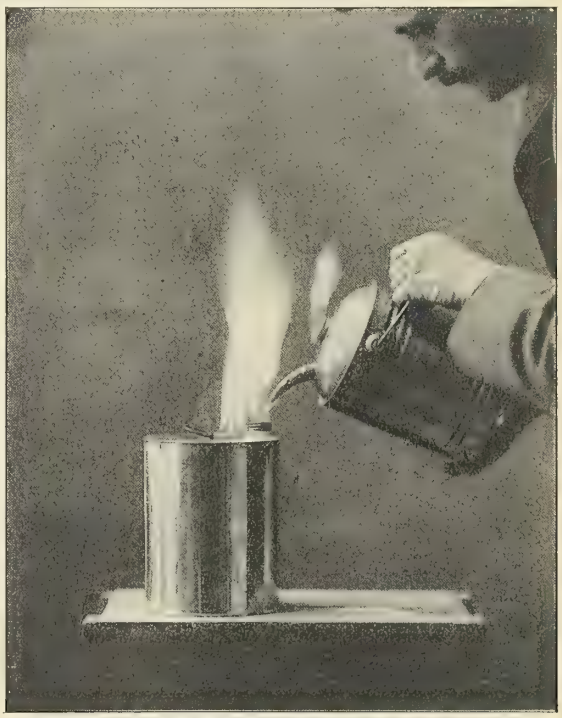


FIG. 19.

usual process of decay could not ensue, and the fleshier portions of these animals were finally transformed into petroleum, which finally settled into cavities and the interstices of the Trenton shales. The familiar term "coal oil" is therefore a misnomer, for, although hydrocarbons similar to the petroleum products have been artificially produced from coal, those in nature are undoubtedly of animal origin.

Passing from the general to the specific, the properties of gasoline will now be discussed. C naphtha, having a specific gravity of between 68 degrees and 78 degrees Baume, is quite volatile, vaporizing voluntarily at ordinary temperatures and boiling at temperatures ranging between 160 degrees and 260 degrees Fahr., according to density. The evaporation is so rapid at ordinary temperatures that a vessel partially filled with gasoline will soon drive all the air from that part above the liquid, so that it contains gasoline vapor alone. Since gasoline

vapor will not explode unless it has a certain proportion of air mixed with it, the contents of the vessel above the liquid are nearly always non-explosive. In order to illustrate effectively this and other properties of gasoline, the writer has performed several experiments before the camera especially for this article, the photographs being reproduced herewith.

In Fig. 18 is shown an ordinary gasoline can, nearly full, to which a lighted match is being applied at the opening. That the gasoline takes fire without explosion may be readily seen by the large flame above the opening, the result being practically the same as lighting gas at a jet. No explosion could possibly follow in this case, as there is no air in the can, and a close inspection shows, before the match is applied, that vapor is slowly issuing from the can.

In Fig. 19 is shown a seemingly dangerous operation, in which half the contents of the can in Fig. 18 has been emptied into another receptacle and the vapor lighted at the opening. To accentuate the flame a small quantity of gasoline has been poured on top of this can. Gasoline is being poured through the flame into the can, as is plainly shown in the photograph. This experiment may be performed with impunity, the only precaution necessary being to keep the hands out of the way of the flame so as not to scorch the fingers.

In Fig. 20 is shown a can from which is issuing a tiny flame, the vapor burning as it passes from the can. The writer is about to extinguish the flame with his handkerchief, showing a simple but effective method of extinguishing a fire on the top of any vessel containing gasoline. In fact two or three smart blows in rapid succession with the bare hand will accomplish the same result without the slightest inconvenience. This was the method employed in extinguishing the flame after the experiment shown in Fig. 19, the blow of the hand on the filling hole at the same time extinguishing the flame at the spout because of the forcible ejection of the vapor, driving the flame too far away for it to get back. The blazing gasoline on *top* of the other can soon burned itself out, and a blow of the hand was sufficient to extinguish the tiny flame remaining at the opening.

The ensuing illustrations show experiments made at the instance of the advisory editor of MARINE ENGINEERING, and are to disprove the popular superstition that a lighted cigarette or a lighted cigar will ignite gasoline or its vapor. In Fig. 21 is shown a lighted cigarette which was smoked furiously for a moment, in order to secure a very bright spark, and then held over the opening of the can. At the time the photograph was taken the cigarette had been held in the position shown for fully fifteen seconds. The writer has tried this experiment a number of times, both in the manner shown and by holding a cigarette or a cigar in an explosive mixture of gasoline and air. In no instance was it possible to secure ignition.

In Fig. 22 the writer is seemingly very brave, smoking a cigar at a rapid rate with the burning end held over the opening of the can. The ashes had been carefully knocked from the cigar, so as to give the vapor the greatest possible access to the burning tobacco. In the photograph the smoke issuing from the cigar is plainly visible, although the writer is uncertain whether it will reproduce in the half-tone.

In Fig. 23 the small cup is filled to the brim with gasoline, and the photograph is taken just as a brightly-

FIG. 20.

burning cigar is plunged therein. The result is exactly the same as if the cigar were to be plunged into water.

FIG. 21.

The spark is extinguished with considerable sputter and the generation of quite an amount of vapor.

The cigar shown in Fig. 24 has first been lighted and then thoroughly saturated with gasoline. The cigar is a

fresh one, yet the writer smoked it to within an inch of the end without a flame appearing, although the "snipe" contained a considerable quantity of gasoline, and immediately burst into flame on attempting to relight it with a match. Perhaps this would not be a very pleasant experiment for the average individual, but the writer may say that he is quite accustomed to the taste of gasoline, and, with the exception of a possible slight tendency to light-headedness, suffered no inconvenience whatever.

I have just received from Prof. Durand a clipping containing an account of the recent explosion on the *Lucy R,* which the newspapers attributed to the tank taking fire from the spark of a cigar. This would seem a contradiction of the results obtained by the previous experiments, but the writer believes that, if the truth were to be told, the cause of the explosion was an entirely different one, and that this part of the story had its origin in the brain of the reporter.

This story reminds the writer of the explosion on the *Fulton* some two years ago on Long Island Sound. This explosion has been quoted by the manufacturers of an engine using kerosene as a fuel as a "new and disastrous proof of the exceeding danger accompanying the use of gasoline." In regard to this explosion a gentleman has written me as follows: "The explosion on the *Fulton* was not due at all to gasoline, but to hydrogen gas originating from the storage battery." Incidentally it may be mentioned that the explosion on the *Fulton* was at the time attributed to a lighted cigarette. Although the writer has not had an opportunity to try a lighted cigarette on hydrogen, he does not believe that even this lightest of gases can be ignited in this manner. This opinion is founded upon the statement of Mr. Percival Spencer, of London, a balloonist who has, in all probability, made more ascensions than any man living. In reply to a question propounded by the writer, he stated that, so long as a cigar had been lighted before entering the car of a balloon, there was no danger of igniting the gas from that source.

One often reads of a balloon exploding by catching fire. This is a popular fallacy, for, although several balloons have caught fire, there is no record of a balloon explosion following such a disaster. If the neck of a balloon is tied tight and it is sent to an extreme altitude, the rarefaction of the air will cause the balloon to explode simply on account of excessive pressure of the gas contained in the envelope. A conflagration, however, does not necessarily follow.

A parallel case to the above is found in a tightly closed vessel containing gasoline which is exposed to an excessively high temperature. The heat will generate vapor, just as steam is generated in a boiler, and the vessel will explode in the same manner as the balloon, but unless a flame is in the immediate neighborhood the vapor will not take fire. As an instance the writer remembers a benzine can which exploded in the above manner in a printing office, but no fire followed.

Many so-called gasoline explosions are really nothing more than gasoline fires, starting usually with a receptacle catching fire and then being upset by some excited person. Nevertheless it is quite possible to produce a gasoline explosion, as the following instance will illustrate: In the factory where the writer is employed a workman was testing out a gasoline tank with water. No gasoline had been in the tank for ten days, except what little remained after the tank was emptied. Wishing to solder the tank, the workman stepped to the forge to dry it. In a moment there was an explosion; the tank was flattened out, but, fortunately, the workman escaped injury. As it requires but 124 volumes of gasoline to 1,000,000 volumes of air to make an explosive mixture, it will be seen that a gasoline tank must be nearly dry to contain an explosive mixture.

FIG. 22.

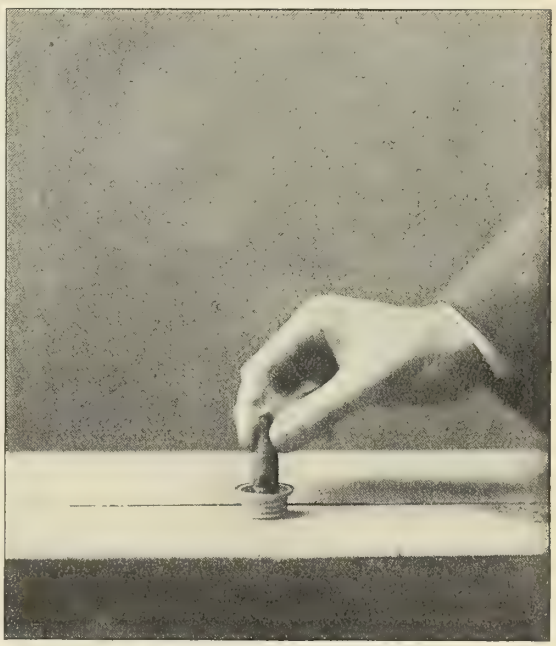


FIG. 23.

In a boat driven by a gasoline engine precautions

should be taken to avoid leaks into the locker spaces and all enclosures where a very small quantity of gasoline is likely to become mixed with a large proportion of air. If the engine room is enclosed it should be well ventilated, as should the space around the gasoline tank and all spaces where gasoline is likely to enter. Gasoline should be led from the tank to the engine through a lead pipe, all joints of which should be sweat joints, well made. Besides the convenience of lead pipe for passing around corners, it is not so likely to spring a leak as other materials when it is subject to strain or some heavy object is dropped upon it. If a leak is found, stop it absolutely, as a leak partially stopped is very likely to be worse than if it had been left alone; for a small quantity of gasoline is more likely to cause an explosion than a large one.

FIG. 24.

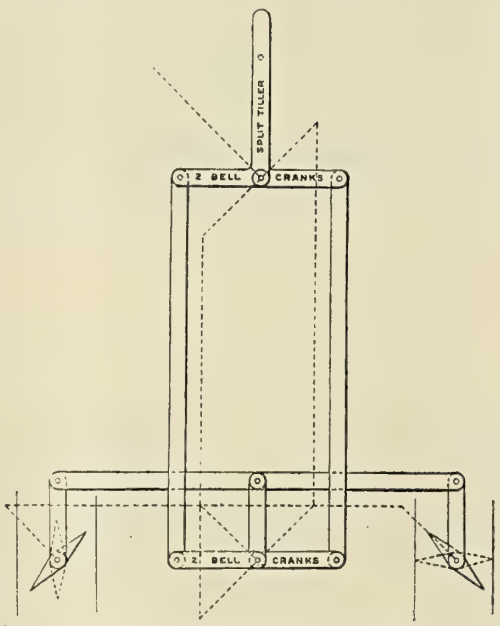
If, by any mischance, gasoline takes fire and a fire hose is available, use it so as to wash the burning gasoline into the sea, and get away from that portion of the water on which lies the burning gasoline. This should never be done, however, if the burning gasoline is liable to be carried on top of the water to other inflammable property, unless it is absolutely necessary to save life. A gasoline fire of small proportions may be beaten out with a blanket or a coat, but a much better extinguisher is flour, which will float on top of the liquid and smother the flame. Sand or loose earth will also answer the purpose, but, as it sinks to the bottom of the liquid, it is not quite so good as flour. A bottle of strong ammonia thrown into an enclosure in which gasoline is burning, or in fact any fire, will often prove a very effective extinguisher. Chemical fire extinguishers are also much better than water, and they should be invariably carried in a gasoline launch of any proportions.

In conclusion the writer would say that the so-called dangerous properties of gasoline are to a great extent purely imaginary and have no existence in fact. With ordinary care a gasoline engine is not nearly so dangerous as a steam boiler, and does not require nearly the attention necessary in the care of the latter to prevent accident. This statement is amply verified by the exceedingly small number of accidents that have occurred to the power plants of gasoline boats from the gasoline itself.

(To be continued.)

Steering Gear for Twin-Screw Vessels.

The accompanying diagram is a device patented by Mr. V. de Michele, of Rochester, England, for steering twin-screw steamships. The plan consists in fitting a special throttle valve to each set of engines, and connecting these throttle valves by bell cranks and linkwork to a tiller, as indicated in the diagram. With the tiller in the central position, each engine receives an equal supply of steam; but on moving it over, as indicated by the dotted lines, the valve throttles the supply to one set of engines, causing them to run more slowly, and so steering the ship. The tiller is split in halves; normally these halves are connected by a pin dropped through the hole shown, so that they work together as a single piece; but by removing this pin one half can be put hard over one way, and the other hard over the other, opening wide or closing both the valves, as may be desired by the steersman.



NEW STEERING GEAR FOR TWIN-SCREW SHIPS.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 106 vessels of 28,209 gross tons built in the United States and officially numbered during the month of July, 1902. The largest steel steam vessels included in these figures are: The *Harold B. Nye, A. E. Stewart, Panay, James H. Hoyt,* and *Thomas Adams,* aggregating 20,000 gross tons and all built on the Great Lakes.

Hospital Electric Launch.

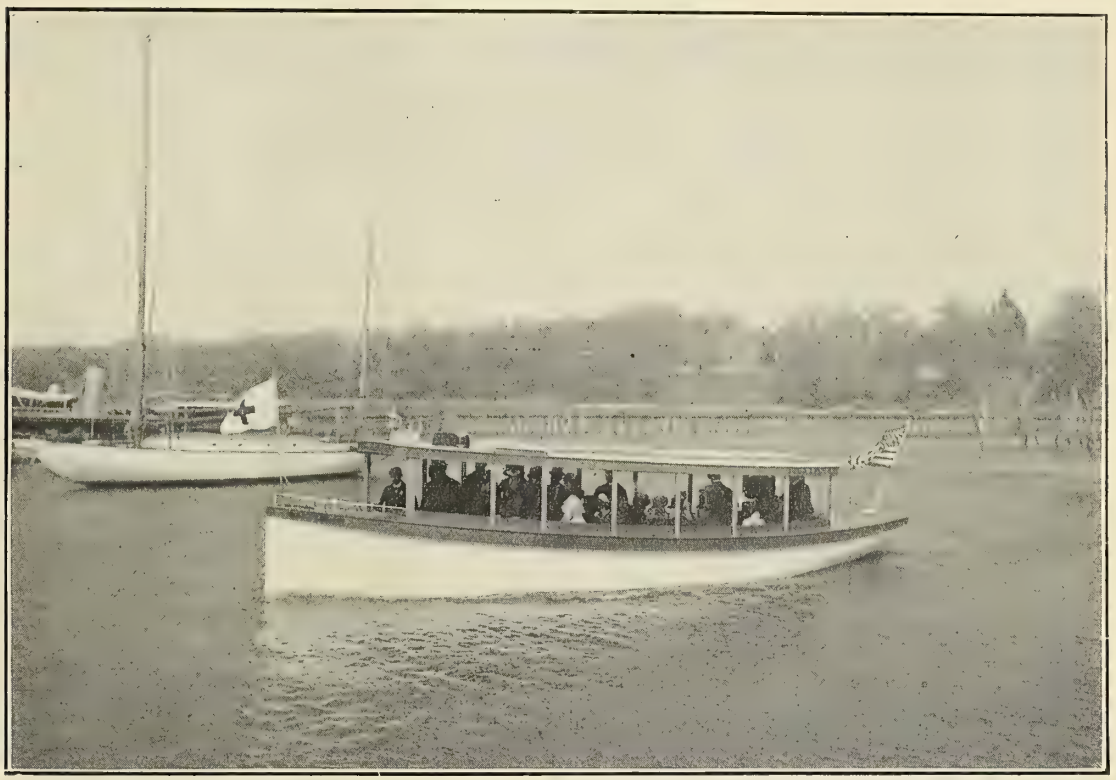
A novel craft has recently been completed by the Electric Launch Company, of Bayonne, N. J., to be used for the St. John's Guild, New York city.

The accompanying plans and engraving exhibit the general type of the vessel, and the description of the hull and the principal dimensions are as follows:

Length over all, 38 feet.
L. W. L., 35 feet.
Beam, 9 feet.
Draft, when loaded, 2 feet.
Freeboard amidships, when loaded, 2 feet 6 inches.
Length of forward deck, 6 feet.
Length of after deck, 7 feet.
Head room under carlins of roof, 6 feet.
Two side entrance hatches, 2 feet by 2 feet.
After hatch, 8 feet by 5 feet.

The launch is designed especially for transferring sick children between the floating hospitals of the St. John's Guild and the Seaside Hospital at New Dorp, Staten Island, the floating hospital barges anchoring about a mile off shore on account of shoal water. The boat has seating capacity for 40 adults or 60 children. It is the first electric ambulance launch ever built. Power for refilling the batteries when exhausted is obtained from the electric-lighting plant of the Seaside Hospital, one man being all that is necessary to operate, charge, and care for the launch.

The boat is finished in white enamel and has three entrance hatches and a wide stretcher hatch making an opening in the roof so that a full-size stretcher can be lowered from the hospital barge directly into the launch without disturbing the occupam



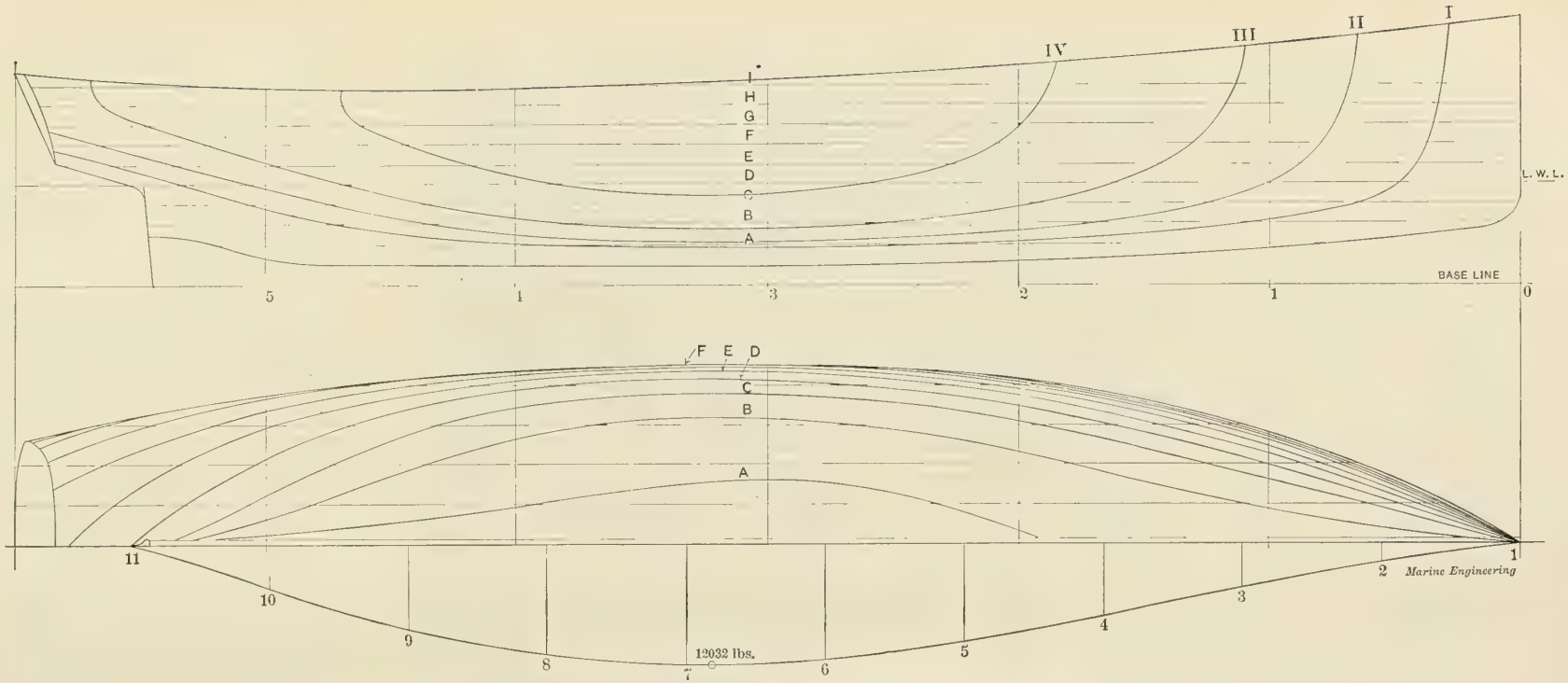
HOSPITAL ELECTRIC LAUNCH MARGARET FOR ST. JOHN'S GUILD.

The keel, shaft log, stern timber, transom, transom knee, and forward deadwood are of white oak, copper bolted, and riveted on rings. The keelson is of yellow pine and the frames are of oak, steam bent and spaced ten inches between centers. The floors are also of oak, sawed with natural crooks at the ends. The clamps are of yellow pine. The planking is laid with one-inch cedar, copper fastened and wood plugged; the bilge clamp is of yellow pine, and the shelf of the same material. The shear strake, plankshear, and moldings are of oak. The seams are calked with cotton, paved and puttied. All butts are cut between timbers and riveted to oak butt blocks. The breast hooks and upper knees are of oak, and heavy oak rubbing strips are placed on each side of the launch at the edge of the plankshear, and are protected by iron.

The cockpit is level throughout and laid with tongue-and-groove pine, supported upon oak floor bearers, with provision for batteries and motor under same. The sides of boat in cockpit and forward of bulkhead are ceiled in yellow pine above the floor line. Slatted seats, which extend around the side, are also of yellow pine.

The roof covers the entire cockpit, is strongly built and supported upon oak stanchions and carlins. The ceiling is of white pine, the roof is covered with canvas, sized and well painted. The sides are closed by roller storm curtains of the street-car type for protecting the occupants from the sun and storm.

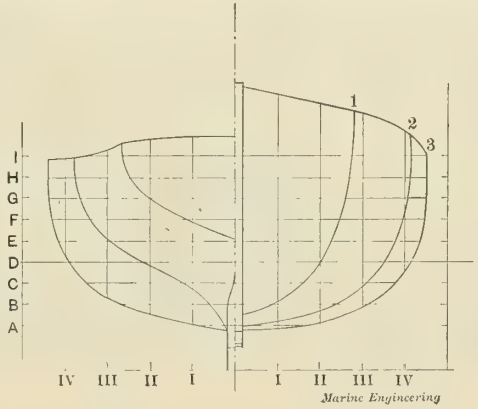
The power of the boat is supplied by an 8 H. P. electric motor, which is placed beneath the flooring and is directly connected to a Tobin bronze propeller



WATER LINES, BUTTOCKS, AND BODY PLANS OF THE HOSPITAL ELECTRIC LAUNCH.

shaft. All the bearings are self-lubricating, and a thrust bearing of the ball type is fitted. There are eighty-four "Chloride Accumulators" of the 9LL type. The elements are placed in patent hard-rubber cells with tight-fitting wood covers, and all are stored under the flooring of the launch, resting upon patent porcelain insulators, giving air space around each battery.

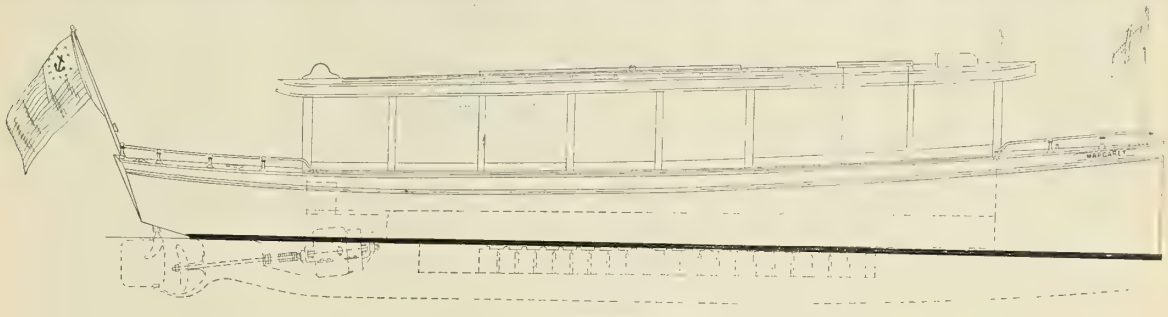
The controller is placed under the forward deck and operated by a shaft extending through the steering wheel bearing. By means of this controller five different speeds ahead and two reverse speeds may be given to the motor. The speeds of this launch, by actual test, are given below. The hours to run and total miles covered are by calculation.



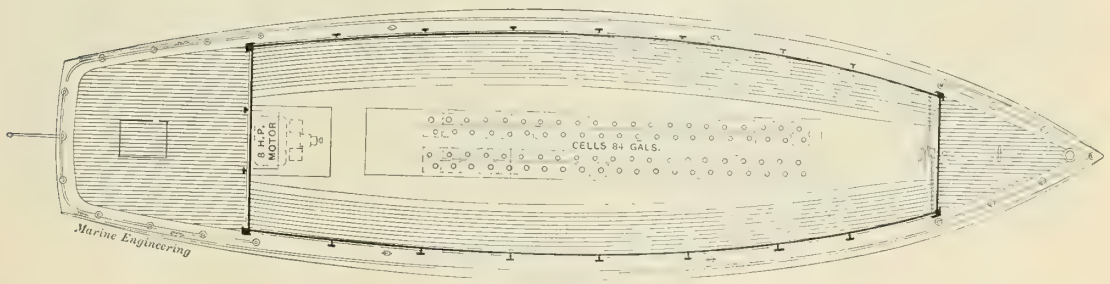
Controller.	Speed Miles per Hour.	Hours to Run.	Total Miles Covered.
1	5.75	14	72
2	7.05	10	70 1-2
3	7.93	5	39.65
4	8.61	3 1-2	30.13
5	8.97	For fifteen minutes.	

The *Margaret* was launched with full power equipment and was propelled under its own power immediately after touching the water. It is a gift to the St. John's Guild by Mr. Isaac N. Seligman, of New York.

The Syren and Shipping.—The day for new marine papers seems to be at hand, judging from the several new publications which have recently appeared on our Atlantic and Pacific coasts. The latest one to be introduced to the public is the American edition of *Syren and Shipping*, illustrated. *Syren and Shipping* has for many years held a leading position in English maritime affairs, and so successful has it been on the other side that the manager has decided to open an American edition, the form of which will be closely along that of the home paper. It is stated that the contents from week to week will include illustrated articles, description of principal harbors and docks, shipyards, tools, etc. Leading articles will be written by experts on subjects of maritime interest; the editorials will take up current topics. Under the headings of "Ships that Pass in the Day," "Syren Observatory," "Sidelights on Shipping and Commerce," "On and Off the Ways," "Marine Insurance Notes," "Shipping and Finance," "Wall Street," "Freight and Fixtures," "The Produce World," "Black Diamonds," "The Iron and Steel Trade," are promised much interesting news and description. The head office of the American edition is 313-315 Maritime Building, New York city. The paper will appear weekly, on Saturday. Domestic subscription price is $5 and the foreign $6.50.

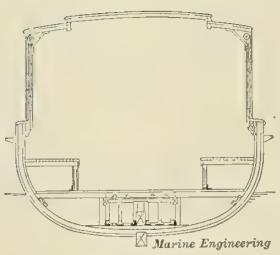


SHEER VIEW



PLAN

PLAN ELEVATION AND SECTION OF HOSPITAL ELECTRIC LAUNCH.

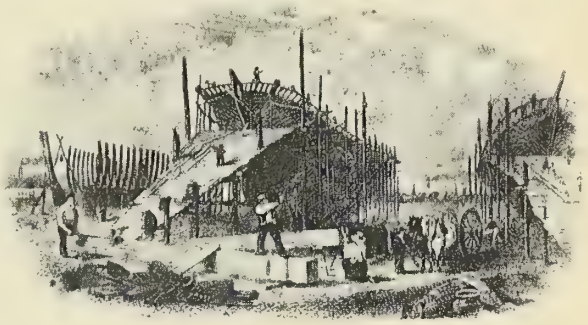


Old Shipyard.

Editor MARINE ENGINEERING:

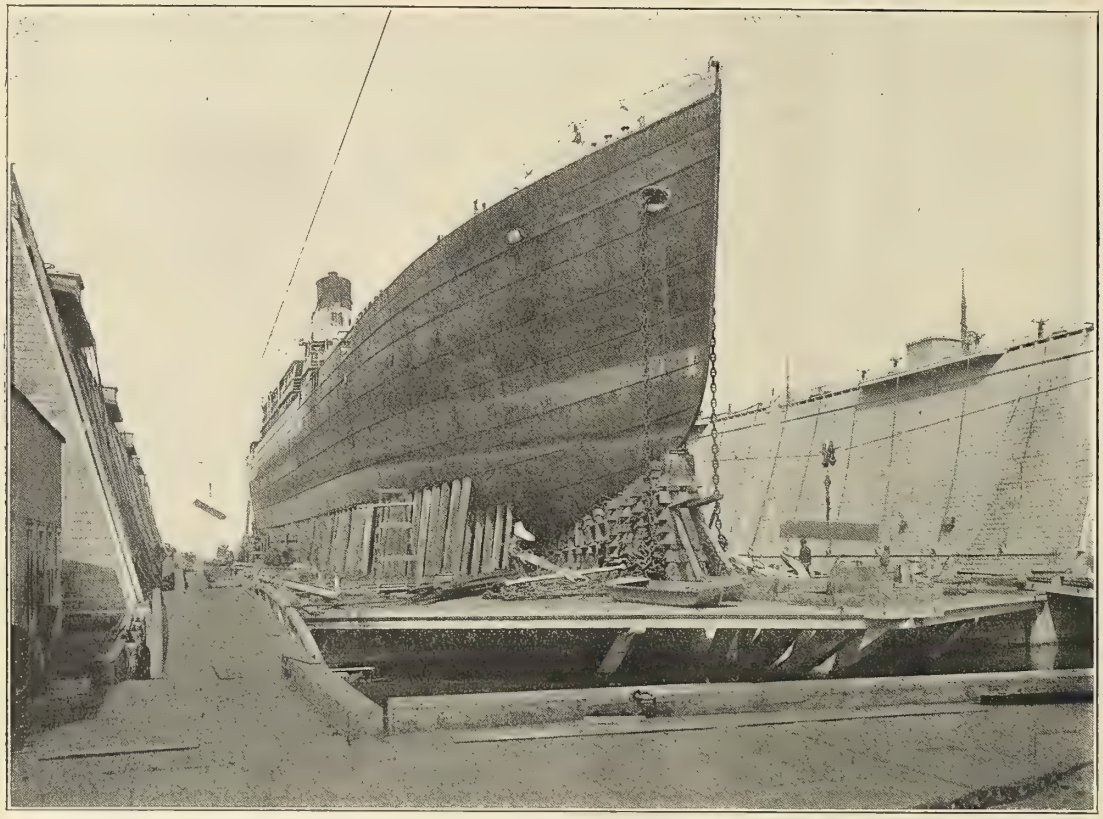
You have published on several occasions pictures of modern shipyards. Perhaps, therefore, it will interest you to see a shipyard of the old times.

A few weeks ago an old bank building in New Castle, Maine, was torn down, and there was found tucked away in a forgotten corner an old bill issued by the New Castle Bank when it was a State bank. The bill was old and discolored with age. It is supposed that the engraving was made some time before 1840. The accompanying engraving shows the picture on the bill of what was apparently a typical shipyard on the coast of Maine over half a century ago. S. E.



VIEW OF OLD SHIPYARD IN MAINE.

Lake Shipbuilding.—The ships already ordered from the American Shipbuilding Company for 1903 delivery will cost in round numbers $8,000,000. This amount will undoubtedly be increased.



THE U. S. TRANSPORT M'PHERSON IN THE MORSE IRON WORKS SECTIONAL DRY-DOCK, SHOWING EXTENSIVE SHORING.

Building a New Bottom for a Wrecked Ship.

As will doubtless be remembered, the United States transport *McPherson* went ashore in 1898 on the southern coast of Cuba, not far from Cardenas. She struck on a ragged ledge of rock, and many attempts to pull her off proved unsuccessful. Succeeding storms battered the ship until her entire bottom was broken up. After several months of arduous work, contending with many storms, the Merritt-Chapman Wrecking Company, New York, succeeded in floating the *McPherson* and towing her to New York. The wreckers had undertaken the work with the understanding that if she were not salved they would get no pay, and as weeks passed by and the vessel was not floated, but daily becoming worse, the Government was not anxious to have her salved.

When the ship first struck, tons of the pig iron ballast were thrown overboard to lighten her. This ballast was thrown on the off-shore side of the ship and thus, in a measure, acted as a barrier against floating the vessel. However, by building several cofferdams in the hull, patching up the holes and filling the bottoms with tons of cement, the water was pumped out and the ship floated.

In towing the *McPherson* to New York a heavy storm was encountered, which broke the tow line, and again the ship drifted on shore. She was, however, finally brought to New York and docked on the new floating sectional dry-dock of the Morse Iron Works, South Brooklyn. Inspection showed that the bottom plating and framing was broken from the stem to within 100 feet of the stern. When the ship was put up for auction the only bidder offered $12,000. The Government decided not to sell her at this figure, and she remained several months moored at the shipyard and kept afloat by continuous operation of wrecking pumps.

After several months the Government decided again to sell the ship, and she was knocked down to the Luckenbach Dredging Company of New York for about $10,000. The purchasers gave the job of repairing her to the Morse Iron Works, and she was shortly after docked for the most extensive repairs to the hull of a ship ever carried out in this country.

Owing to the condition of the bottom, no keel blocks and but few bilge blocks could be used in docking the vessel, and the method of supporting her by shoring is clearly shown in the accompanying illustrations. The form of floating dock was especially adapted for docking such a vessel as this, because of its elasticity.

The condition of the bottom is clearly shown in the illustrations on page 471. The *McPherson,* formerly the German ship *Obdam,* is one of the old type of English-built steamers, 460 feet long and but 40 feet beam. This exceptionally small beam gave her greater longitudinal strength, which probably accounted for her holding together as well as she did. Her bar keel was bent upward into the hull at a point about 40 feet from the stem, and from there aft the frames, plating, and all longitudinal and transverse members were broken and twisted. It was necessary to build an entire new bottom from bilge to bilge. The hold stanchions had

What Remained of the Bottom Forward of Boiler Room, Looking Forward.

Damage Under Forward Collision Bulkhead, Foot of Stem at Center of Picture.

VIEWS OF THE DAMAGED BOTTOM OF THE U. S. TRANSPORT M'PHERSON.

been jammed up through the lower deck, and many of the deck beams, besides all these stanchions, were replaced. Several bulkheads were also rebuilt. The boilers were shored up from the dock and the bent bottom cut out underneath them. The engine-room bedplate was broken and most of the bottom below the engine room was also rebuilt. The engine was completely dismantled and all parts taken to the shop. The shafting had been twisted out of line, but the same sections were used over again. Aft of the engine room the damage was not so severe as it was in the fore body, but a new stern post and rudder had to be fitted.

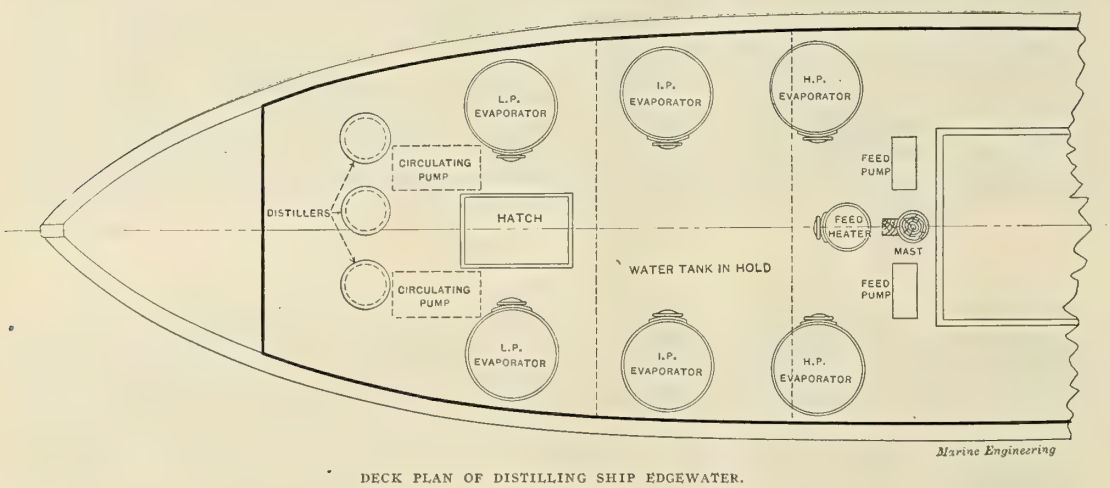
All this work was completed in the remarkably short time of six weeks. The cost of repairs to the hull alone amounted to about $80,000. One appliance which greatly facilitated the work is the overhead trolley, erected on either side of and extending the length of the dock, as seen in the view on page 470. By this means the plates and members were quickly removed from under the bilges, taken to the yard, and new plates returned. This kept the dock comparatively clear. The system was designed and installed by the Morse Iron Works.

As the vessel neared completion, a most interesting and bitter contest, concerning the securing of an American registry for the ship, started between the owners on one side and the San Francisco and Hawaiian Steamship Company on the other. The owners claimed that as the vessel was flying the United States flag, was owned by the United States Government, and was wrecked on the shores of a United States possession, she was entitled by law, after undergoing such extensive repairs, to United States registry. The opponents, however, claimed that granting this registry to the vessel would violate the spirit of the law, and would prove a hardship to their (the S. F.-H. S. S. Co.) company, and to other lines that had in service American-built vessels which cost anywhere from $400,000 to $500,000. The new vessel is named the *Brooklyn*.

Marine Review and Marine Record.—Under date of August 14 the first number of the consolidated papers, *Marine Review and Marine Record*, appears. It is in improved form, published by the Marine Review Publishing Company, Cleveland, O.

Distilling Ship Edgewater.

A very interesting distilling plant was recently installed on the steamer *Edgewater* by the James Reilly Repair and Supply Company, of New York. The vessel was bought by the British Government and the work was under the supervision of Mr. W. Blackburn Smith, consulting engineer, of this city, as the special agent for the Government. The Edgewater was formerly a steam lighter, built at Rondout, New York; is of white oak, and is 96 feet long over all, 25 feet beam, and 7 feet 6 inches draft. The propelling machinery consists of a compound engine with cylinders 16 and 27 inches in diameter by 16 inches stroke, driving a 6 feet 6 inch propeller. There is a Wheeler surface condenser, an independent centrifugal circulating pump, and a duplex air pump. The single elliptical Scotch boiler is 9 feet long, 8 feet 6 inches wide, 11 feet high, fitted with two corrugated furnaces 42 inches in diameter, and has a heating surface of 38 square feet. The evaporator and distilling plant were placed on the forward open deck, with the exception of the two circulating pumps which were placed in the hold. This forward deck was afterward housed in, and the sides were carried to the after end of the original deck house. As seen in the illustration, the bow is protected by a breakwater.



DECK PLAN OF DISTILLING SHIP EDGEWATER.

The plant consists of six steel-shell evaporators, each 5 feet in diameter by 8 feet in height; three copper-shell distillers, each 2 feet 3 inches in diameter by 4 feet 6 inches in height; one steel-shell feed-water heater, 2 feet 6 inches diameter by 5 feet 6 inches high; two duplex brass fitted feed pumps for feeding salt water to evaporators; two duplex brass-fitted circulating pumps for circulating sea water through the distillers, and one brass-fitted tank pump for pumping distilled water from tank in hold of vessel to reservoirs on shore. The cut above gives the general plan of plant.

The evaporators work in two separate and distinct triple effect plants, one on the port and the other on the starboard side, but are so cross-connected that one or more shells can be cut out for cleaning without interfering with the working of the remaining shells. Steam at 100 pounds pressure is supplied to the evaporators and pumps, as well as to the main engine, by the above-mentioned boiler.

One feed and one circulating pump only are required to operate the entire plant, the extra pumps being for emergency. The evaporators are of the Quiggins type, as manufactured by the James Reilly Repair and Supply Company, and are fitted with large rectangular doors to facilitate the removal of coils for cleaning. The feed-water heater is of the marine type, similar in design to those installed in the feed lines of a large number of steamships and yachts by this company.

This portable distilling plant was built to supply fresh water to the Boer prisoners who were confined on several of the small islands in the Bermudas. The vessel was to evaporate sea water, and steam from island to island and deliver fresh water from the storage tanks in the hold to the receiving tanks on shore. She can proceed from port to port under her own steam at a speed of four knots, and at the same time run the evaporators. When the evaporating plant is not running the speed is ten knots.

The plant was designed for an average capacity of 25,000 gallons in 24 hours while sailing at a four-knot speed.

The official test was made under the direct supervision of Commander F. S. Leslie, commanding the Royal Engineers in Bermuda, and the following results were obtained:

Capacity in 24 hours, 50,240 gallons.
Boiler pressure, average, 87 1-2 lbs.
Pressure in shells, H. P., 26 lbs.
Pressure in shells, I. P., 13 lbs.
Pressure in shells, L. P., 1 lb.
Temperature, Fah., salt feed, 200 deg.
Temperature, Fah., circulating water, 67 deg.
Temperature, Fah., fresh water discharge, 95 deg.
Temperature, Fah., feed suction, 90 deg.
Discharge, 90 deg.

The *Edgewater* is equipped with lifeboats and other appliances necessary to pass inspection.

DISTILLING SHIP EDGEWATER, BUILT FOR THE BRITISH GOVERNMENT SERVICE IN THE BERMUDAS.

This plant was installed with great promptness, as only four weeks elapsed from the time the order was placed until the boat was completed and ready for sea.

An Old Ship.—What is stated to be the oldest ship in the world was recently sold in the Canary Islands and broken up. It is the Italian vessel *Anita,* registered at the wharfs of Genoa. The *Anita,* which resembles Christopher Columbus' ship, the *Santa Maria,* is stated to have been built in Genoa in 1584, and, up to within a few weeks, has been in commission on ocean voyages. She was exceedingly heavily built and during her long career weathered countless storms and tornadoes in all parts of the world.

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IT is only a truism to say that no topic which presents itself for the attention of the designer, builder, and operator of ships and shipping is of more importance than that of safety to human life. It must, however, be admitted that it has thus far not received the attention, and is not receiving the attention, which is so clearly its due. Its importance is only too often drawn to our attention by catastrophes more or less serious, but the sum total of our efforts, in the past decade for instance, has produced but slight advance, and it seems not far wrong to assert that, in comparison with advances in technical and engineering matters, improvements looking to increased safety are sadly lagging behind.

We should perhaps define here what we mean by safety at sea. We do not mean absolute safety from natural disturbances. That is obtainable nowhere. The most that could be asked is that the risk from such disturbances be reduced to what it would be on land in the quiet and regular routine of a settled domicile. This is perhaps asking too much, but nevertheless it may well be taken by those interested in this question as a goal toward which to work, and because its complete attainment is perhaps unlikely is no reason for lack of effort in this direction.

Among the reasons for the relative neglect of provision for safety we may note, first, the exceedingly difficult nature of the problem. There is no doubt that the adequate safeguarding of life at sea is one of most tremendous difficulty. Nature has her fits of passion difficult to foretell, impossible to forestall, and in such the provision which we may have deemed all-sufficient is ruthlessly swept aside. The problem is one which has enlisted in modern times a vast amount of effort, but with indifferent results.

A further and still stronger reason is found in the fact that, like all other good things, increased safety at sea can only be purchased at the expense of other features. A ship, like all other engineering structures, is a compromise between mutually opposing considerations. No one feature can be present in especial prominence except at the sacrifice of others which are to be desired. Thus it would be relatively easy to construct a ship in which all other features would be sacrificed to safety at sea, and in which a long step toward the attainment of ideal conditions might be made. Such a ship, however, would be slow in speed, limited in carrying capacity both for passengers and cargo, and the necessary price for either would be so high that from a commercial standpoint the venture would be a dismal failure.

This brings us to the most important of the reasons why ships are not safer than they are or why more attention and prominence are not given to this feature in modern marine practice. It is simply and solely because the public does not demand it. In accordance with social and economic laws these matters adjust themselves strictly in accordance with the demands of the public; those whose servants the ship builders and ship owners really are. The demands of the carrying trade both for passengers and for freight, both as regards price to be paid and speed of transit, are at the present time such as to preclude the highest expression of the feature of safety. Both the modern traveler and the modern shipper prefer some increased risk with high speed and lower price rather than greater safety with lack of speed and higher price.

These remarks are in particular true with regard to means of safety which require a large expense in weight, space occupied, initial cost, cost of maintenance, etc. It does not follow, however, that because the introduction of certain

features will necessarily lead to some compromise, and to an undesirable change in valuable features of the ship, that we are doing the very best we can with the weight, space, cost, etc., which we are ready to assign to considerations of safety. Here is the opportunity for the inventor or the student of improvements in this direction. We may be sure that the existing combination of features which prevails in modern practice is by no means the best, and that, without any material loss in other valuable features, some other combination may be found which shall furnish a notable improvement over present conditions. This is the problem which is now attracting much attention, but thus far with no very notable results.

Here again public sentiment may do much in prompting such study by showing to inventors that the time is ripe for their best efforts, and to ship owners and designers that special attention paid to such features will prove a strong advantage in the race with competitors. To state again our main proposition: ship builders and operators are the servants of the public, and, within the limits of modern engineering practice, the public can have what it wishes by speaking for it and by accepting the consequent conditions. In the meantime there is no doubt but that the public would like increased safety, but without loss of other features; that is, without accepting what would naturally be the consequent conditions. Doubtless improvements can be made along these lines and under these limitations, and these are the problems which will certainly repay the most persistent and careful study on the part of all who are concerned with serving the public in this manner.

GASOLINE, like many other natural products, is a good friend and servant, but a merciless and destructive enemy. Its attitude, whether that of a servant and friend or enemy, depends solely on the way in which it is used. Intelligent use insures the former, ignorance and carelessness the latter. Intelligent use demands a good understanding of the physical properties and peculiarities of gasoline, and to this end Mr. E. W. Roberts has prepared for our readers the article which we publish elsewhere in this issue. It is there shown that gasoline has been often blamed unjustly and feared unnecessarily, while at the same time just grounds for caution are clearly stated. We would commend a careful perusal of this article to all who are interested in the use of gasoline in any manner whatever.

THE present situation as regards naval ordnance and armor is one of especial interest. The performance of the Army 12-inch rifle firing a shell loaded with the new high-power explosive and fitted with the new time fuse, in piercing 12-inch Krupp armor, has established a new record for penetrative and destructive power, and for the moment scores a point for the gun in the ceaseless struggle between guns and armor. The success which the Army ordnance officials have thus attained in penetrating modern armor with projectiles loaded with high-power explosive was first announced in a paper read at last fall's meeting of the Society of Naval Architects and Marine Engineers, and naturally awakened the keenest interest among all those concerned with naval design and construction. Later developments and improvements have amply confirmed these results, and penetrations have been realized indicating the possibility of carrying a charge of high-power explosive through even 14 inches of Krupp-process armor. This means the possibility of piercing with an explosive shell the armor belts of our heaviest battleships, and thus of setting at naught the best efforts of the naval designer in the protection of the vital features of his ship.

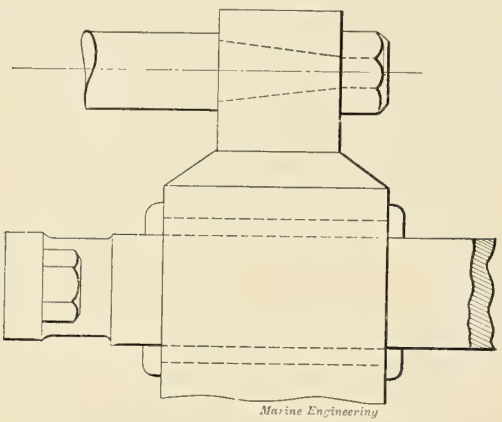
It is small wonder that naval designers feel that the immediate future of the armor question is involved in considerable uncertainty. In the meantime, however, a note of interest has been made public regarding a process intended to offset, at least in some measure, this latest advance of the gun. We refer to a new process for face-hardening armor proposed by Lieut. Cleland Davis, U. S. N., and which is now under investigation at the ordnance works of the Bethlehem Steel Company. The method, in outline, consists in subjecting the face of the plate to the influence of electric arcs of enormous power, and passing between carbon terminals of peculiar form and disposition. Under these circumstances it is found that carbon is carried into the face of the plate to a depth depending on the time employed, but which in any case is far less than for similar surface carbonization with the Harvey or Krupp processes. Following this subjection to the influence of the electric arc, it is found that the plate is susceptible to face hardening to a degree even beyond that attained by the Krupp process. The chief trouble thus far has been with the question of uniformity, but the results have been so promising as to give strong grounds for the hope that in this way a decided advance may be made over the results reached with the Krupp process.

MISHAPS AND REPAIRS.

Derangement of Reversing Gear.

Editor MARINE ENGINEERING:

At the recent dock trial of the new S. S. *Mackinaw* a somewhat peculiar derangement occurred to the reversing gear which for a time baffled the efforts of a number of competent engineers to locate. The main engine is of the ordinary vertical triple-expansion type, having cylinders 17, 27, and 43 inches in diameter, respectively, by 24 inches stroke. The high-pressure valve is of the piston type, 9 inches in diameter, and the intermediate and low-pressure valves are of the ordinary double-ported slide type, and, consequently, rather difficult to work owing to the great amount of friction. The reversing engine is 9 inches in diameter by 11 inches stroke, and apparently amply large to reverse the engine under any and all circumstances. Unlike the ordinary arrangements, this reversing engine was bolted to the back of the intermediate cylinder, and worked vertically on a reversing arm keyed to the reversing shaft, which works in brackets secured to the short back columns of the engine.



CROSSHEAD GUIDE OF REVERSING ENGINE.

Steam was put on the engine in the early morning, and the reversing engine and gear worked in an entirely satisfactory manner. As the engine was run continuously for ten hours, there was no occasion for using the reversing engine until the end of the dock trial. It was then found that the reversing engine absolutely refused to move. The working lever and the valve of the reversing engine worked all right, but the piston would not budge. It was suggested by some one that the valve had slipped on its stem; the valve-chest cover was removed and the valve was found to be in place, and it was also proven to work very easily on its seat. Another wiseacre diagnosed the difficulty as coming from a lack of lubrication of the slide valves. Oil was therefore pumped into both the intermediate and low-pressure valve chests; the engine was run ahead for a few moments until the valve seats could be well lubricated, but still the reversing engine refused to be moved. Another wise man suggested that the packing ring of the reversing engine piston was fitted too tight and had jammed, but this was found not to be the real cause. Although there were a dozen experienced men around the engine room, none could seem to suggest a remedy. On the following day, after the engine had cooled down, a systematic search was made to locate the trouble. A block and fall was hitched to the links, but the united efforts of three men did not cause them to move. It was finally decided to strip the entire reversing gear. Before much had been done in this direction the real cause was detected. The reversing engine crosshead had simply nipped on the crosshead guide. This guide was arranged as shown in the sketch.

The guide was of the ordinary bar type, of forged steel. The crosshead was also of forged steel, but the working surfaces were composed of brass gibs fitted as shown. It was seen at once that the gibs had been made a neat fit in the shop, and, upon becoming heated, the difference in expansion had simply caused them to nip on the bar guide. As the reversing engine was bolted to the intermediate cylinder, the guide and crosshead did not become heated up when the main engine was first started. After running all day everything about the reversing engine was, of course, thoroughly heated up and, as a result, the foregoing derangement took place. The brass gibs were subsequently scraped down, and no trouble has been experienced with the reversing gear since.

C. A. MCARTHUR.

Engine Breakdown on U. S. S. Manila.

Editor MARINE ENGINEERING:

I send you herewith an account of the breakdown of the compound engine of the U. S. S. *Manila,* which occurred on a recent voyage from Honolulu to Bremerton, Wash., while I was chief engineer. At the time of the accident we were approximately 1,200 miles from the former place, 1,300 miles from the latter, and 1,100 miles from San Francisco, dead to leeward.

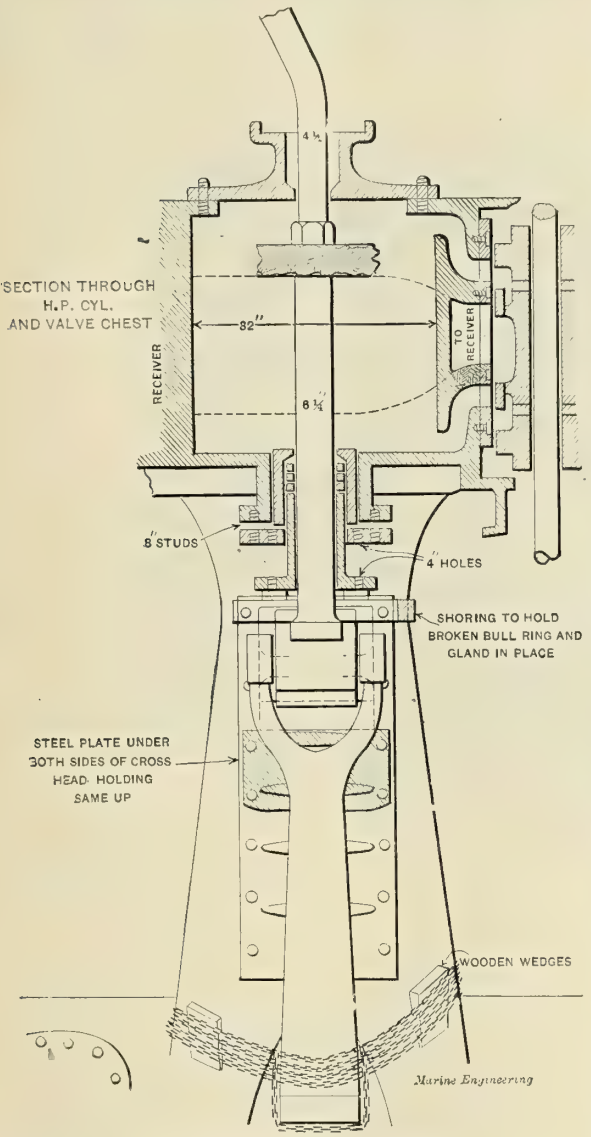
The *Manila* was built in Scotland in about 1881. She was used by the Spanish navy as an army transport until her capture by Admiral Dewey in the battle of Manila in 1898. Since that time she has been used by our navy as a cruiser and latterly as the station ship at Cavite. She is about 1,600 tons displacement, and has one compound engine with cylinders 32 and 60 1-2 inches diameter by 39 inches stroke, which drive a four-bladed screw 13 by 18-foot pitch.

The air pump, circulating pump, and main feed and bilge pumps work off a beam connected with links to L. P. crosshead. The H. P. delivery valve is a single-ported D-slide with a Meyer expansion valve working on its back; the L. P. is a double-ported D-slide. The valve motion consists of Stephenson double-bar links, controlled by a rocker shaft and worked by a continuous motion combination hand and steam reversing engine. Backing and go-ahead eccentrics are secured by set screws and keys to the crank shaft, and the expansion valve is worked from a crank on a face plate bolted to the end of the shaft. The condenser forms part of the back housings, and the front columns are hollow for use as oil tanks. Jacking gear consists of a worm and wheel mechanism driven by a rope belt from flywheel of ballast pump.

The engine works at 65 to 75 pounds steam pressure and makes 60 revolutions per minute, develops about 750 I. H. P., and propels the ship through smooth water

at about 9 knots per hour on 15 to 16 tons of coal, 7 gallons of lubricating and lighting, and a half-gallon of cylinder oil per day. The H. P. and L. P. distributing valves have small balance pistons. The H. P. crank leads L. P. by 90 degrees.

At 2.42 P.M., June 1, 1902, while running at 58 turns, the H. P. piston broke without warning. The men on watch heard a clack resembling water in the cylinder, followed immediately by a crash caused by the breaking



BREAK AND REPAIRS OF H. P. PISTON.

piston. There was a shower of débris from the bottom of the H. P. cylinder, and much live steam escaped into the engine room through the rupture; fortunately no one was injured.

The H. P. cylinder and valve-chest covers were taken off, and the links, eccentric rods and straps, and crank-pin brasses stripped from the engine; the crosshead was shored at the top, and the connecting rod was lashed with chain to the back column. The following damage was found to have occurred: H. P. piston broken into fragments; tail rod bent in two places, remaining about 4 inches out of line; cylinder liner cracked on after side from the lower edge diagonally upward about 18 inches; six of the eight studs holding stuffing box to bottom of cylinder broken squarely off, and the stuffing box broken at the fillet joining the barrel to the flange; crack in go-ahead crosshead slipper, and a bad break in the false valve face and wall between lower steam port and receiver. The piston, which was 21 years old, was of cast iron, flat and hollow, with four cells.

After a careful inspection of the broken parts the accident was accounted for in the following manner: A small piece of the lower wall of the piston, containing part of the threading for a core-hole plug, and one core-hole plug were found in the receiver. The fragment of the piston had two pronounced sand holes and about 2 inches of bad metal along two of its fractured surfaces, and the piston giving way along these lines allowed the core-hole plug to drop while it was making an up-stroke. On the next down-stroke the plug was swept into the exhaust port and met the lower edge of the port of the valve, which was then traveling upward, and wrecked the valve face; when the piston reached the end of this down-stroke it broke into pieces, leaving a hub about 15 inches in diameter on the rod; on the up-stroke the tail rod bent in the first place, and on the next down-stroke the hub caught the wreckage in the bottom of the cylinder between its lower surface and the stuffing box, breaking the latter and precipitating part of the broken piston, some of the follower bolts and piston springs, and fragments of the stuffing-box flange into the engine room.

The valves were removed from the H. P. valve chest, and the remains of the stuffing box and its gland blocked into the bottom of the cylinder against the crosshead, which was held up by steel plates bolted to the slides on either side; melted babbitt was then poured around the piston rod and calked and the cylinder cover replaced. The tail rod was so badly out of line, however, that it was necessary to spring it with differential purchases before the cover would go on. The stuffing box in the cover was then filled with melted babbitt. In this manner the H. P. cylinder was cut out, and steam passed directly from the high-pressure valve chest through the receiver to the L. P. delivery valve.

From 1.30 to 8 P.M. on the second day we tried to start the low-pressure engine, but were unable to get it over the centers. It was noticed that it bound most on the quarters, so the beam was stripped from the crosshead and the air pump guttered, the idea being to run the L. P. engine with high-pressure steam and exhaust into the atmosphere through the air-pump relief line. Investigation showed that there was too much cushioning in the L. P. cylinder, and it was decided to set the go-ahead eccentric back in order to do away with leads. The setting of the valve was equalized by removing liners from under the heel of the eccentric rod, and the angular advance of the eccentric was reduced from approximately 44 degrees to about 13 degrees. It was wanted to reduce the lead to about 4 degrees and allow steam to follow the piston on both ends practically its whole travel; this, however, would have brought the set screw just at the edge of the keyway in the shaft, and the eccentric was moved ahead so as to allow the shoulder of the keyway to take against the

set screw, and the latter was backed by a small piece of wrought iron. The engine then turned slowly and evenly, but it was found that the boilers would not generate steam rapidly enough to run at high pressure, and the sea washing back through the already cramped exhaust line choked the engine. The air pump was reassembled and the beam connected to the low-pressure crosshead and the engine jacked to its top center, so that the impetus caused by its fall would carry it over the bottom center. It was found, however, after one or two failures, extremely dangerous for a man to try to remove the worm from the jacking gear when the L. P. piston was free to move. The crank was therefore shored with the engine on the top center, and steam turned into the lower part of the cylinder through the starting valve in order to form a cushion. A slight vacuum was produced in the condenser by the use of one of the auxiliary pumps and the engine thoroughly cleared of water. At about 2 o'clock in the afternoon, June 4, with everything in readiness, the blocks were knocked away, and, as the force of the drop carried the crank over the bottom center, the throttle was opened wide. The revolution was completed, and the engine ran in this condition for 1,100 miles, making nearly 450,000 revolutions.

It was soon found that no greater pressure than was carried in the receiver when compounding could be used, on account of binding of the low-pressure valve against its face; and as the engine made about 40 turns with 17 pounds absolute in the receiver and 22 inches of vacuum, without straining itself very much, she was allowed to run in this way. The consumption of coal and oil was very slightly less than when compounding at full power. Without further accident we reached San Francisco on the afternoon of June 12.

H. J. ELSON, Ensign U. S. N.

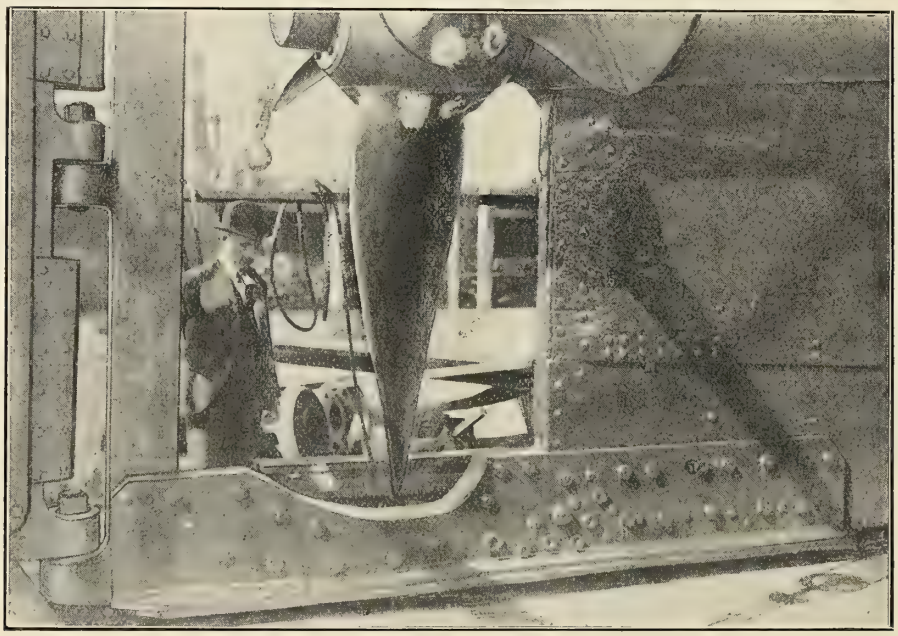
Repairing a Stern Frame.

Editor MARINE ENGINEERING:

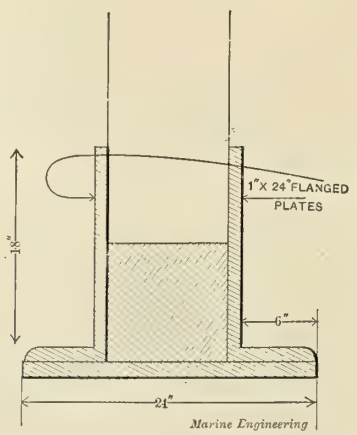
We send you herewith photographs showing repairs recently made by us to the stern-frame forging of the steamship *Oregon*. This vessel has had the misfortune of breaking her stern frame twice in succession; the first time, which occurred last fall, caused the loss of the rudder and rudder post.

As shown in the photograph, the aim in the recent repairs was to make that portion of the frame, namely, the shoe, which has been the source of trouble, amply heavy, with a view of preventing a recurrence of the mishap. The break was located in the shoe, close to the propeller post. Three 1 by 24 inches steel plates were used, as shown in the sketch, the ones on the sides being flanged. All the fastenings are of 1 1-4-inch rivets and 1 1-2 body bound bolts, as shown in the photograph.

M. B. C.



STERN FRAME, BROKEN IN THE SHOE, REPAIRED BY SIDE AND BOTTOM PLATES.



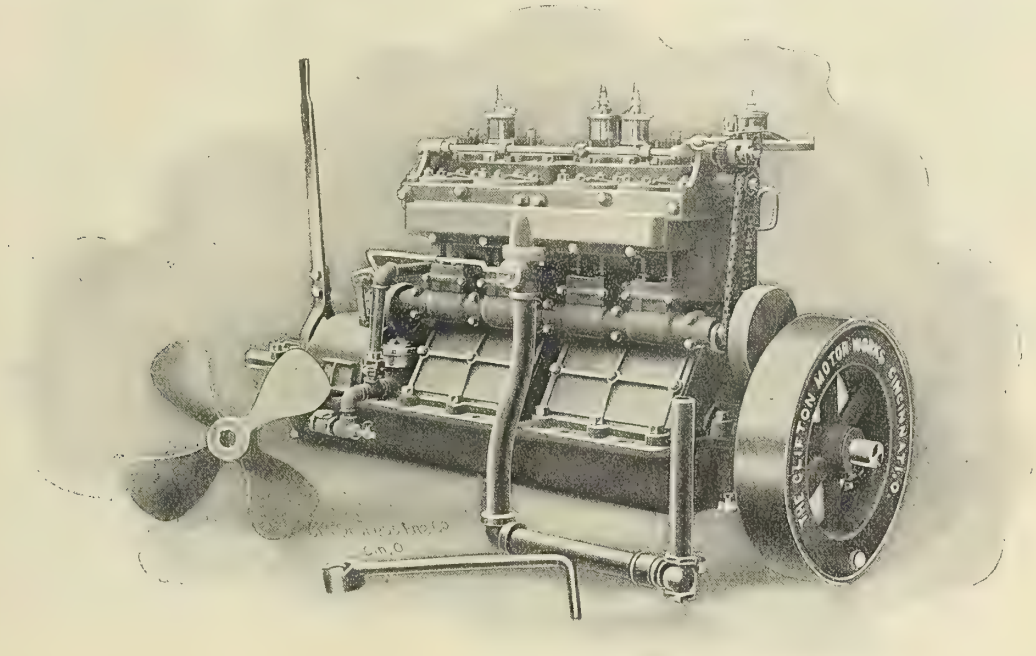
ENGINEERING SPECIALTIES.

Marine Gasoline Engine.

The accompanying engraving illustrates a four-cylinder, 16-horse-power marine engine built by the Clifton Motor Works, 229 East Clifton avenue, Cincinnati, O. From the view it will be seen that this is a compact and a symmetrical piece of machinery. The number of parts has been reduced to as few as possible, and, at the same time, nothing has been sacrificed to simplicity. The engine embodies the latest improvements to be found in this type of gasoline engine, and also several improvements that are distinct innovations.

The bed of the engine is a strong casting, as light as possible consistent with the necessary strength to withstand the strain. The cylinders are cast in pairs, with all the inlet and exhaust openings, water jacket, cores, etc., cast complete. The exhaust is carried between the two cylinders and is taken out on the opposite side from the valves. There is a great advantage in this, as the exhaust is always warm and often quite hot. Being taken out on the opposite side, there are no hot pipes to be encountered in oiling the moving parts of the valve and igniter mechanism. This feature makes the engine more symmetrical in design. The inlet and exhaust valves are both opened mechanically and have large lift. The cam shaft is operated from the main shaft by gears, which are enclosed in a light gear case to keep them clean, and also to prevent injury and deaden the noise. The cam shaft is carried in a cylindrical case bolted to the side of the cylinders. This case also carries the guides for the valve push rods. The cams and push-rod rollers run in oil and are entirely dust-proof.

The igniters are of the make-and-break type, self-contained in separate removable castings. These latter may be taken out by loosening two 3-8 nuts, and replaced with equal facility. Each igniter is operated by a separate cam on the igniter shaft. All are in full view on the tops of the cylinders. The time of the spark may be retarded or advanced by means of a lever, which also operates a switch for cutting out the battery and cutting in the magneto or dynamo as the engine increases its speed. Reversing is accomplished by means of a mechanical reversing gear in the bed of the engine. A governor is also provided which operates a throttle and prevents the engine running away when the propeller is stopped.



FOUR-CYLINDER MARINE GASOLINE ENGINE.

A New Electric Hoist.

Various attempts have been made to design an electric hoist capable of handling heavier loads than come within the range of hand hoists, and not requiring the heavy and expensive supporting structures necessary to carry the large amount of dead weight of ordinary traveling cranes. The hoist shown in the accompanying illustration fulfills these requirements, and is protected by patents owned by the Sprague Electric Company. It is designed to transfer light work rapidly around shipyards, factories, etc., and when supplied with trolley carriage, geared hand cross-travel and bridge-travel motor, to take the place of small traveling cranes.

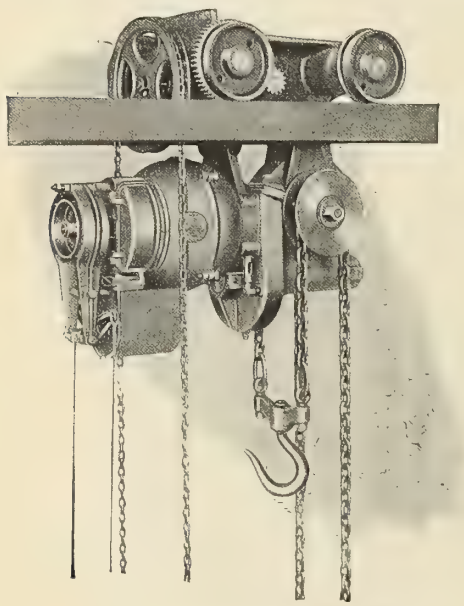
This hoist has many advantages over other equipments, and has a new system of motor control for electric hoists. It has a high efficiency and is much smaller and lighter than any other hoist of like capacity, and is practically indestructible. It consists of few parts, all of which are interchangeable, it is easily adaptable to all types of runways and bridges, and the sizes range in maximum capacities from 1,500 pounds to 10,000 pounds. The smaller sizes can be equipped with a trolley arranged to run on a single rail or I-beam, and,

if so arranged, will take curves of a reasonably small radius.

In designing this apparatus the manufacturer has carefully kept in view the fact that it would be subjected to rough usage. All parts are made of great solidity and of the highest grade of material, while all bearings have been made self-oiling, requiring but trifling attention at long intervals.

All the different movements necessary for a traveling crane, namely, hoisting, lowering, cross travel, and bridge travel, are controlled by a simple pulling of the chains and cords connected to the mechanism, and which can be operated by the ordinary workman. This is a unique feature, to which special attention is called, no special crane operator or cage being necessary.

The motor and hoisting mechanism can be hung from



NEW ELECTRIC TRAVELING HOIST.

a strap if only a hoisting and lowering motion is desired, or they can be attached to a trolley carriage arranged for cross travel, either by pushing the load or by a geared hand traverse motion. A bridge travel is also provided, the controller for which is mounted on the end of the trolley carriage, as shown in cut. This controller is operated by cords, the handles of which are located near the work. The bridge-travel motor itself is mounted in some convenient position on the crane. The bridge-travel motion is reversible, and in practice it is possible to obtain a very short movement in either direction.

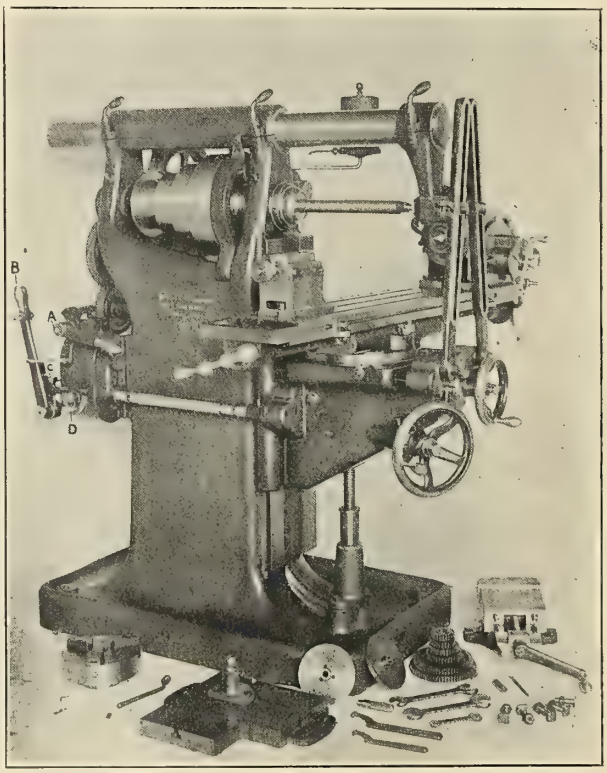
The motors furnished with this equipment are Lundell round-type motors, entirely enclosed, and the hoist can be operated out-of-doors without being affected by the weather. The resistance plates for the bridge-travel controller are of the enclosed type and have a very large overload capacity.

The Sprague Electric Company manufactures and furnishes the complete hoist as shown. A very complete description of the hoist is given in Bulletin No. 20,915, which may be obtained by addressing the manufacturers, 527-531 West 34th street, New York city.

New Model Universal Milling Machines.

The Becker-Brainard Milling Machine Company, of Hyde Park, Mass., has placed upon the market a new line of plain and universal milling machines from new designs and patterns. These machines embody many new features, special attention being given to strength, power, and rigidity in order to meet the demands of modern milling machine practice.

In the universal machines the spindle is connected with the change-feed mechanism by a train of three spur gears, thereby eliminating the usual feed pulleys and belt, giving positive gear drive necessary for heavy and rapid cuts.



NEW UNIVERSAL MILLING MACHINE.

The change-feed mechanism is a novel feature and obviates the loss of time in changing gears, as was formerly the practice in old-style machines. The feed is obtained and driven by the main spindle through a train of three spur gears on the back of the machines, which drive two nests of change-feed gears in the column. By compounding the gears in the upper nest the various changes of feed are secured, giving, with the quick change in the gear case on the outside of the machine, twenty changes of feed for each spindle speed. The changes are made by the simple movement of the levers, bringing them into position as indicated on the index plate, which is at the top of the feed box, and has each feed plainly marked on its face. When the fast feeds are desired, the quick-change lever is thrown into the hole marked "fast."

The power is transmitted from the change-feed mechanism through the telescopic shaft connecting, by gears, the longitudinal, transverse, and vertical feeds, which

are reversed by a lever on the side of the knee within easy reach of the operator. Both transverse and vertical feeds are operated and controlled by a lever located on the side of the knee, which, when central, disconnects both feeds, and when thrown into position for one feed it is impossible to connect the other.

Another important feature is a clutch arrangement enclosed in the hubs of the hand wheels which operate the vertical movement of the knee and cross movement of the carriage. When either the knee or carriage has been set to the required position, the clutch may be instantly disengaged by pressing in the knob on the front of the hand wheel, thereby preventing any accidental change from their fixed position, and also preventing the hand wheels from revolving when the automatic feeds are thrown in.

In designing these machines the greatest care has been taken to secure the highest efficiency, together with accuracy and simplicity. Nevertheless, the parts are so arranged that they are within easy reach of the operator, and of sufficient strength to prevent breakage from undue strain. Metal distribution has been properly proportioned, the base being very solid, thereby absorbing vibration. The arm is a straight steel bar, so that any of the regular attachments can be placed in position without the necessity of its removal.

A Speed-Regulating Device.

A new device along the line on which many inventors are just now approaching the Patent Office—another attempt to solve the problem of greater convenience in speed variation of machinery—is illustrated in the accompanying engravings. The views given illustrate a speed regulator invented by Henry P. White, of Kalamazoo, Mich. The left-hand view is an end elevation and the right hand is a side view, the former having the tight and loose pulleys removed. The inventor has set out with the intention to provide a speed regulator of the cone-pulley type, which may be applied in combination with any desired source of power, and to every class of machine which, in practice, is required to run at various speeds. The design also embodies a construction in which the different portions of the contact surface of the belt travel at the same relative speed upon the surface of each cone, thus avoiding the necessity of a compensating slip at contact surface of the belt.

The natural advantages which the inventor claims for this improved mechanical speed regulator are, first, its range of variations in speed is practically unlimited, as it may be designed to secure any variation which practice will demand; second, its spring-regulated belt tension acts as a safety governor in the operation of machinery; third, its automatic speed indicator makes it possible for the operator to always know at what speed his machine is running; fourth, the easy and practical means it provides for securing any speed intermediate to the two extremes embodied in the design of the machine does not require the operator's hands to come in contact with the belt; fifth, its simplicity of construction, which eliminates every undesirable complication.

The main frame is indicated by *A*, and *B* is the driven cone, mounted upon a shaft which carries the tight and loose pulleys, through which power may be applied to the machine. A corresponding cone, *C*, is mounted upon a shaft located at right angles to the one on which cone *B* is fastened, the pulley *C'* being the medium by which power may be delivered to the machine. A track, *E*, is fastened to the main frame, or is a part of *A*, having a sliding frame, *D*, with a shaft, *I*, and idlers, *H*. *G* is a screw and hand wheel by means of which the sliding frame may be moved along the track, *E*. The dotted lines show the position of the belts when the sliding frame is moved to the opposite end of the track, and the relative places at which the belts are applied will also indicate the proportionate speeds of the cones.

Where the contact surface of the belt travels at the same relative speed on all the pulleys involved there is very little loss from friction, except in the journals of the revolving portions of the machine. The device

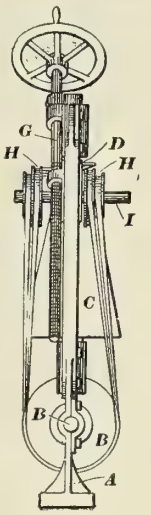


Fig. 1.—End Elevation.

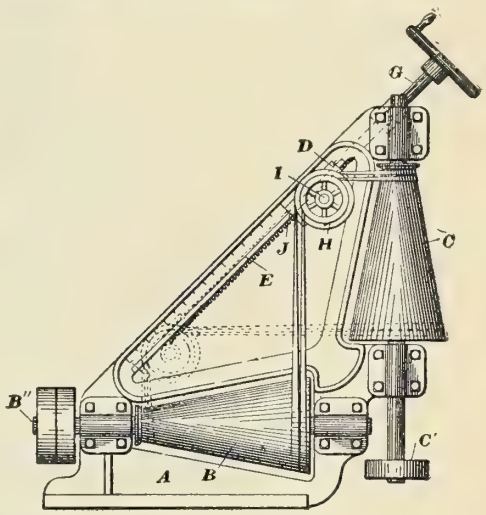


Fig. 2.—Side Elevation.

CONE SPEED REGULATOR.

shown embodies this feature, of such vital import to success in practice. It is made by the New Era Manufacturing Company, of Kalamazoo, Mich.

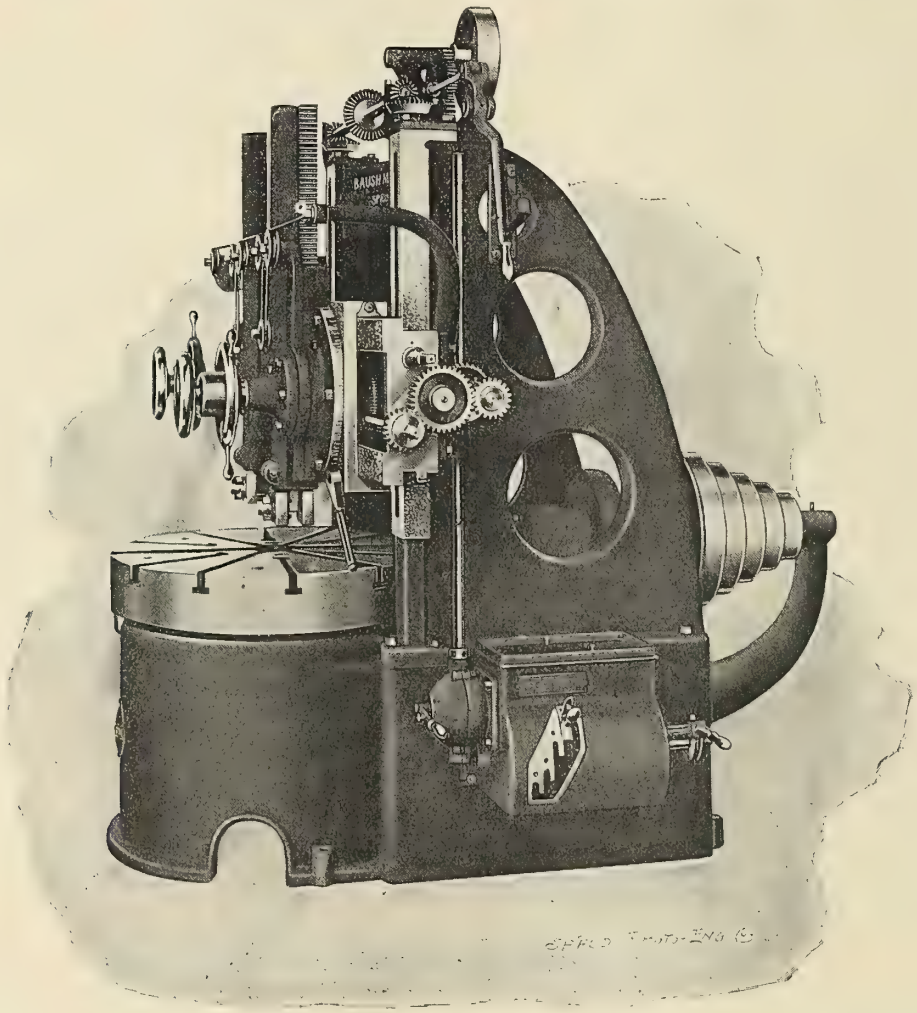
Boring and Turning Mill.

In the accompanying illustration will be seen the 37-inch latest-type turning and boring mill made by the Baush Machine Tool Company, of Springfield, Mass. The care with which the design and construction of this machine have been carried out is evident by inspecting the illustration.

The bed is a solid casting to which the vertical arms are bolted with stud bolts, and to these arms are attached the cross-rails, which are fitted with two heads. The heads can be operated independently of each other by means of a split nut and rack and pinion, and thus be moved back and forth very quickly, which greatly facilitates setting up the different classes of work. There are independent feeds for each head, operated by the Hendey-Haughton device, giving fifteen changes ranging from 1-64 to 9-16 of an inch vertical feed, and from 1-64 to 7-8 inch horizontal per revolution of the table. The change from one speed to another is made almost instantly and without stopping the mill. The cross-rails are raised and lowered by power; the pulley,

as shown in the illustration, is placed in the center at the top and is operated by a lever, thus doing away with the belt from the countershaft. The back gears are arranged so that they can be thrown in and out by means of a lever, without the use of a lock nut.

The table can be removed and replaced by an independent, or an independent and universal chuck. It has an outer bearing with a self-oiling device which guarantees constant lubrication. The main bearing is large and is hung with a hole through the center, allowing the chips to pass through to be removed from the bottom of the mill without clogging. Though the machine is usually built for belt drive, yet it is made so that it can be driven by a motor by removing the cone and bearing and attaching a motor to the bed. The company makes this mill in five sizes, namely, 37, 41, 51, 54, and 61 inches diameter.



A BORING AND TURNING MILL OF THE LATEST TYPE.

The Battleship Maine.—The new battleship *Maine* was dry-docked at the Brooklyn Navy Yard in preparation for the official trial, which took place on August 23. On the builder's trial the figures for speed given out by Messrs. Cramp were 18.29 knots.

New Battleships.—The Navy Department invites bids which are to be opened on October 1 for the new battleship *Louisiana,* one of the two which were recently authorized by Congress. The other battleship, the *Connecticut,* will be built in the New York Navy Yard. These two vessels will be identical in every detail in order that there may be a comparison made between the cost of Government and private construction.

Importing Steel.—Imports of steel billets and pig iron are on the increase, and many vessels have been chartered to bring steel shapes and plates from Great Britain and Europe. Much of this is to be used in completing the ships now under contract. The demand at home is so great for steel that the yards have had to go abroad for their material.

Oil-Fuel Tests.—The Navy Department is conducting a series of tests of oil fuel at the Washington Yard to determine the desirability of using oil as fuel on warships. A water-tube boiler has been mounted similarly as aboard ship and careful determinations are being made of evaporation, etc. It is understood that the various systems of oil burning will in turn be tested.

PRACTICAL POINTS IN SHIPBUILDING.

BY EADS JOHNSON.

Practical ideas and details of ship construction are not to be found under any fixed or standard rules. Methods of construction vary in different yards, as facilities for handling material determine, and still, if two yards were fitted with identical means for erecting and handling the materials which go to make up a ship's structure, it is doubtful if the same methods of construction would be followed in the two cases. Each and every constructor has ideas of his own, and, although vastly different from each other, they bring out the complete ship as though all intermediate steps were the same.

Under the headings to follow it is hoped to give as broad and general methods of construction as possible. They are not, however, intended to be taken as settled or ideal methods, but merely those which have been followed and have been successful.

PREPARATIONS FOR RECEIVING THE FIRST FRAME ON KEEL OF STEEL SHIP.

From the mold loft on scrieve board, the half-breadth at the midship frame or the frame selected to

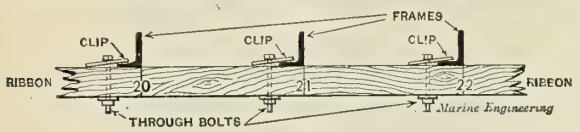


FIG. 1.

erect is obtained, and the height of ribbons and their location on frame are also noted.

The frame spacing is laid off on 4 by 4-inch or 3 by 3-inch rough pine ribbons, and the mark of the heel of the frame is scrieved thereon. At a distance of 1 inch from the point where the toe of the angle intersects the rib a hole is bored in the ribbon so that a 5-8-inch bolt may be run through and a large washer or clip is put on, as shown in Fig. 1, with which the frame is secured when set in place.

Now, after having prepared two or more ribbons in like manner to take frames above the bilge, support them at their respective heights, which are to be had from the loft, as before stated. Other ribbons are set alongside of the keel at the proper height above the ground, supported by shores and tied 'thwartships by light ribbons, so that a crib is formed by the ribbons for the reception of the frame. Ribbons should always be located in way of an outside shell strake, so that they can remain until the inner strakes are up and bolted to the frames. These ribbons are run fore and aft of midship as far as the length of timber will allow, and other lengths are butted to them which extend to the stem and stern. These end ribbons are put up after the middle frames are in place.

Now erect the frame, and, after it has been secured, square a line across the keel and prove with a horning batten or steel wire to make sure of the square. Proving with a horning batten is nothing more than proving a square line with a radius. In Fig. 2, *FF* represents the frame and *KK* the keel. A point *A* on the keel forward of frame and one aft the same distance from frame are located. A batten is used that will reach from *A* to a point *B* located on frame any distance from the keel. Now, to make sure of square, see that the distance from *A* to *B* is the same and equal to the distance from *B* to *C*. Sometimes a steel wire is used instead of batten, in which case the same method is followed.

Now place two straight edges on the outermost ribbon under the bilges, and have these set vertically in a

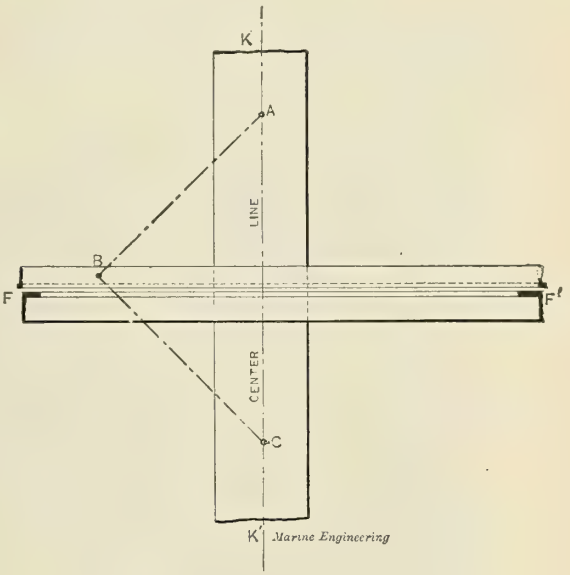


FIG. 2.

plane perpendicular to the keel, then the frame is set in wind with them 'thwartships. This method is shown in Fig. 3, where the straight edges are designated *A* and *B*. Now the frame is made fast to the ribbons, and two or

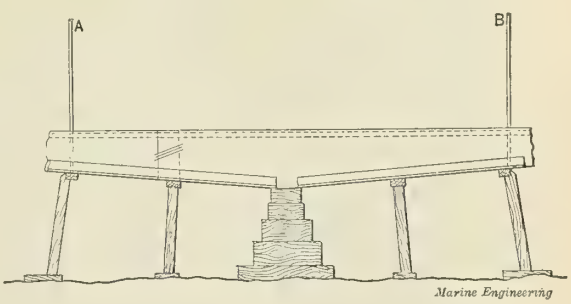


FIG. 3.

three spur shores are put up under each ribbon at an angle of 45 degrees, fastened to the frame by through bolts and to the ground on heavy timbers bedded in earth and staked with long wood screws. These spur shores prevent the frame once set, squared to base line and to the proper declivity, from moving fore or aft. They are usually led aft, but where frames are ex a heavy one spur shore leads forward and may be fastened to the frame at the bilge. Thus having the frame so secured, other frames may be erected fore and aft of this one, and, with the exception of plumbing up and lining after the stem and stern posts are up, no other precaution is necessary to have the ship fairly framed.

SETTING FRAMES.

There are many minor points in setting the frames of a steel ship which may not appear to be of vast importance and which are lost in comparison with larger details, but at the same time they must be carefully carried out and are essential to the proper and true assembling of the ship's structure. We suppose the keel blocks laid and the keel plates on the blocks, with the cradle of ribbons ready prepared with the frames scribed thereon. Suppose the midship frame to have been set and spauled. The frames should then be set in rotation fore and aft of the midship frame, in order that there be no interference, as it is not practical to drop in intermediate frames where the ship has any amount of tumble home, provided, of course, that the frames are bolted securely or riveted on the ground and erected complete.

Where center keelson is continuous, the frames being clipped to the keelson, frames are more easily erected, necessarily being put up in half sections where the above procedure does not apply.

The usual clips are placed on the ribbons to secure the frame in place, and as they are set up the clips secure them in a fore and aft direction to the scribed marks on the ribbons. It is all very well to secure them to the ribbons, provided there is a continuous vertical keel, and the frames may go up in half breadths; but when the frame complete is continuous 'thwartships it should not be secured tightly to the ribbons until it is centered on the keel plate and bolted securely thereon, because if it were bolted to the ribbons tightly, without first having been centered on the keel plate and bolted, drifting might be necessary to fair it up. The corresponding holes of frame and keel and keel plate would be very likely pulled from the

FOREBODY OF THE STEAMER BANES, DAMAGED BY FIRE.

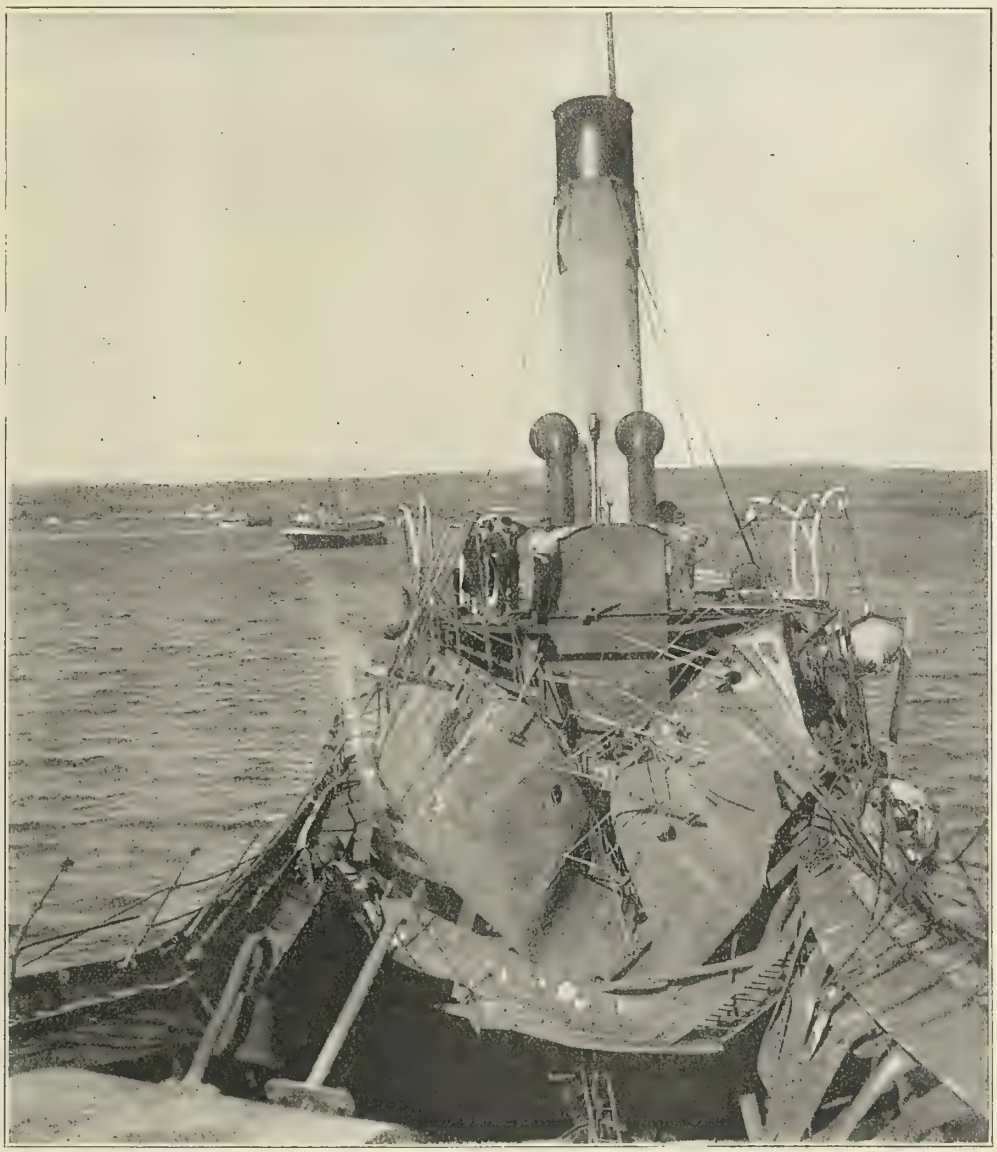
center line and thereby cause unnecessary trouble and expense in lining up afterward. Therefore it is best to have the frame bolted securely to the keel plate and centered before it is secured to the ribbons.

SPAULING.

Should the frames be ready for erection before the beams are ready, the frame is spauled. This is done by using timber not less than 12 by 3 inches in section and long enough to span the frame. The timber is bolted to the frame, port and starboard, about 3 feet 6 inches below the line of the main deck, so that it is held at the correct breadth at that point. This wooden beam is stiffened by using an upright of 6 by 3-inch timber erected at the center and fastened securely to beam and to floor plate, or to the reverse bar on top of floor plate. Thus the frame is held as if it were beamed; and as the wooden beam is held below the line beam, the frame may be beamed later; meanwhile, it may be set and squared as before stated.

Burning of the S. S. Banes.

On a voyage from Mobile, Ala., to Bocas del Toro, Colombia, the steamer *Banes*, loaded with a general cargo, including yellow pine and fifteen carboys of naphtha, caught fire. The fire broke out in the forward hold on the morning of the 29th of December last, when the vessel was 120 miles from the western coast of Cuba; and although it burned for twenty-four hours,



THE STEAMER BANES, DAMAGED BY FIRE, LOOKING AFT.

Capt. Peter Tronstad succeeded in bringing the *Banes* under her own steam into Havana harbor. There a contract was entered into by the owners for repairing the vessel at that port, but, owing to insufficient facilities, it had to be given up.

Messrs. Daniel Bacon and S. E. Turner, of New York, then bought the *Banes* and had her upper works planked up, and in this shape she steamed to New York. The contract for repairs to be completed in forty days was recently awarded to the Perth Amboy Shipbuilding and Engineering Company, Perth Amboy, N. J.

The views of the wrecked steamer, one taken from the bow looking aft and the other from the bridge looking forward, show how completely the upper construction and top sides were damaged, the forebody of the ship above the water line, where the fire was the most intense, having completely collapsed. The repairing will necessitate the following work: The renewal of all frames and reverse frames in the forward hold; all the deck beams, deck plating, and shell plating above the water line; also new collision and fire-room bulkheads and keelsons in the hold. Twenty-five feet of the forward deck house is also to be rebuilt; two decks are to be planked over; the windlass and deck engine are to be repaired, new steering engine fitted, and the ventilators and deck fittings renewed.

QUERIES AND ANSWERS.

Q. 100.—Will you please give, through your magazine, the rules for finding the point of cut-off with the initial and terminal pressure given? Also the rules for finding the terminal pressure when the initial pressure and point of cut-off are given. I have several different rules, but none of them give the same answer. J. P. S.

A.—It is impossible to give you any exact rule for determining the terminal pressure from the point of cut-off, simply because the real expansion ratio is not given by the point of cut-off, and, furthermore, the drop in pressure for a known expansion ratio depends to some extent on the quality of the steam and other conditions. The point of cut-off does not indicate the real expansion ratio, simply because the effect of the clearance is not included. The steam in the clearance space counts, of course, as part of the total volume present, and it is the change in this total volume which fixes the expansion ratio.

To determine the real expansion ratio from the cut-off and clearance the following rule may be used:

Add the clearance per cent. to 100 and also to the cut-off per cent., and divide the former by the latter. The quotient will be the true ratio, including clearance. Thus with a cut-off at 60 per cent. and 12 per cent. clearance the apparent expansion ratio would be $100 \div 60 = 1.66$, while the true ratio will be $(100 + 12) \div (60 + 12)$ or $112 \div 72 = 1.55$.

Having found the true expansion ratio, the final pressure can be found approximately by dividing the initial pressure by this ratio.

Thus, if the pressure at cut-off in the example was 155 pounds the terminal would be nearly $155 \div 1.55 = 100$ pounds. Actually the terminal pressure will be a little less than this, the amount of clearance depending on the special conditions of the case, but usually not exceeding 10 per cent.

By working the same rule backward the point of cut-off may be found approximately for a given initial and terminal pressure. Thus:

Divide the initial by the terminal pressure, and thus find the expansion ratio. Then add the clearance per cent. to 100 and divide by this expansion ratio. Then from the quotient subtract the clearance per cent., and the remainder will be the true cut-off per cent. Thus, for example, with the problem above, having given 155 as the initial and 100 as the terminal pressure, we divide one into the other and find 1.55. Then, assuming 12 per cent. clearance, we divide 112 by 1.55, finding 72. From this we subtract 12, leaving 60 per cent. as the point of cut-off. The true point of cut-off will usually be a little later than the point thus given, due to the fact that the drop in pressure is not in exactly the same ratio as the increase in volume. To take account of this by estimate the terminal pressure may be increased slightly, say 10 per cent. of its value, and then proceed as before.

If you are familiar with the use of logarithms, the following rule will take account of the expansion law as found on the average, and will give very nearly accurate results.

Rule: (1) Add the clearance per cent. to 100 and also to the cut-off per cent., and divide the former of these results by the latter.

(2) Find the logarithm of this quotient and multiply it by 1.15.

(3) Find the number corresponding to this logarithm and divide it into the initial pressure. The quotient will be the terminal pressure.

Or to work the other way:

Rule: (1) Divide the initial into the terminal pressure and find the logarithm of the quotient.

(2) Divide the logarithm by 1.15 and find the corresponding number.

(3) Then add the clearance per cent. to 100 and divide by this number.

(4) From the quotient subtract the clearance per cent., and the remainder will be the cut-off per cent.

It must be remembered that this rule and process gives simply the relation between the cut-off, clearance, initial pressure, and terminal pressure in one cylinder. The total expansion in a compound or triple-expansion engine is quite a different matter, and involves the volumes of the cylinders as well as the point of cut-off in the high pressure.

Q. 101.—Suppose that the L. P. crank pin of a compound engine (marine pattern) broke, or, in other words, cracked so that it would not be safe to run in that condition, what could be done to bring the ship into port? The engine having the air and feed pumps worked off the L. P. Please let me know the best, safest, and quickest way to repair the same at sea. Hoping that you will oblige and give me a remedy, I remain, J. E. B.

A.—We assume you mean that the break in the crank pin is too serious to repair in itself, and that it is a question, therefore, of making the best of your way to port without attempting to repair the broken part. In a case like this the quickest repair is to break the H. P. exhaust connection, and improvise as well as possible an exhaust lead to the deck or to the funnel. The air pump should also be disconnected. The H. P. cylinder may then be worked non-condensing, and will, under these conditions, develop something over one-half the full power of the engine. Of course the engine may not handle very well, and there may be some trouble if there is much backing and filling to be done, but for a quick repair it is the best that can be done. If more time is available the L. P. valve may be removed and the ports blocked off, thus allowing steam to exhaust from the H. P. through to the condenser. The L. P. piston rod may also be disconnected from the crosshead and the piston and rod shored up to the top of the stroke. This will leave the L. P. crosshead and air-pump levers connected to run as usual, and with this arrangement the H. P. cylinder may be operated condensing, with a corresponding increase in power. If suitable piping were at hand it might be more convenient to make up a lead direct from the exhaust side of the H. P. cylinder to the condenser. In any case the L. P. crosshead must be operated in order to drive the feed pumps.

Q. 102.—Thinking of building a 50-horse-power triple-expansion engine, could you give me the diameter of each cylinder? I want the stroke to be 2 inches longer than the bore of the cylinder and the steam pressure to be 200 pounds to the square inch. J. A. W.

A.—Taking a total expansion ratio of 11, we find with an initial pressure of 200 pounds a reduced mean effective pressure of about 37.7 pounds. With a piston speed of 400 feet per minute this would call for cylinder diameters of 4 1-2, 7 1-4, 11 3-4, and with a length of stroke 9 1-4, which is 2 inches greater than the intermediate, you would have 260 revolutions per minute. This would give you a fairly well proportioned engine of moderate piston speed and revolutions, and such as might very probably serve your purpose. The proportions would be improved somewhat, however, by decreasing the stroke and increasing the revolutions. Thus, with a stroke of 8 inches, the engine would be in better proportion and the revolutions would then become 300. This is not extreme at all, and such an engine would well represent the proportions and conditions of modern practice.

COMMUNICATION.

Spacing of Boiler Stays.

Editor MARINE ENGINEERING:

A number of cases have come under my notice lately which show a great difference in the method of staying the segment of boiler heads above the tubes, and I would like to get your opinion as to which you consider the proper spacing of same.

For instance, on page 20 of the British Columbia Laws, just issued, for governing construction of steam boilers, we have the following:

"When the head is flanged and riveted to the shell, a portion of it becomes stiff enough to carry the boiler pressure without depending on the braces. The distance that thus becomes self-supporting may be determined by the following formula:

$$D = \frac{4.484 \times T}{10 \times B} + .5$$

when T = Thickness of head in inches.
B = Safe working pressure of boiler.
D = Distance in inches.

"When the boiler head has several rows of tubes expanded into it, a portion of the head beyond the tube becomes stiff enough to be self-supporting, and it is safe to assume this as two-thirds of the distance determined by the preceding formula."

This I found to require more stays than I have been accustomed to put in. In fact, on a 56-inch boiler which I figured with 7-16-inch heads, suitable for 130 pounds working pressure, the distance D only makes out to be 2 inches, which would require the outer row of stays to be exceptionally large.

Also in a work published by Prof. Wm. M. Barr we have the following discussion of the subject:

"In addition to this, the influence of the flange extends inward, and no braces need be located within 4 inches of the flange radius for pressures less than 100 pounds per square inch; . . . and unless in the case of curved intersections and odd spaces which require a brace, the regular line of braces for pressure not exceeding the above need not be closer than 3 inches.

"The holding power of the tubes imparts sufficient stiffness to the boiler heads as not to require braces nearer than 4 inches, so that in all ordinary calculations the area to be supported would be represented by a segment of a circle of 6 inches less radius than the boiler head, and its base line 4 inches above the tubes."

These, however, I consider not distinct enough for practical purposes. In laying out boilers according to the marine laws of Canada, I have always been accustomed to assume that the flange on the head acts just the same as the stay bolt, and will carry quite safely half way down the first row of stays, they being placed as far from the flange as the plate formula would allow.

If you have any further information or any other authority to whom you could refer me, I would be very glad to hear from you.

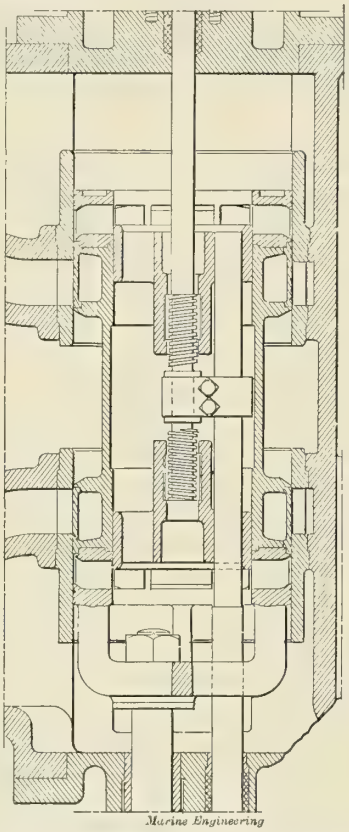
Yours truly, J. F.

We publish the above communication in the belief that it may be of interest to many of our readers, and hoping that it may elicit replies from those whose experience has led them to give attention to the point in question. In the practice of the Advisory Editor, who writes here simply as an individual, it may be said that the line of support furnished by a flange or by a row of tubes properly beaded over or fitted with stay tubes has been considered as equivalent to that furnished by braces of the regular type, and the spacing of such braces has been arranged in accordance with this suggestion.

We shall be glad to hear from any of our readers who may have an opinion to offer on this point.

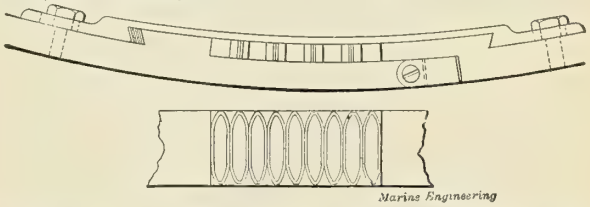
SELECTED MARINE PATENTS.

697,839. CUT-OFF VALVE MECHANISM. JOHN HAUG, PHILADELPHIA, PA.



CLAIM.—3. The combination of the tubular main valve, the duplex cut-off valve contained therein and the adjusting screw for said valve having collars thereon at a point between the two members of the valve, the cut-off-valve stem located on the inside of the main valve, and a two-part clamp engaging said stem and embracing the adjusting screw between the collars of the same. Three claims.

703,590. EXTENSIBLE PISTON RING. OTTO JOHNSON, BROOKLYN, N. Y.



CLAIM.—1. A rabbetted slip joint for connecting the meeting ends of a circumferentially-extensible piston ring, the said joint composed of a relatively long overlapping member provided with an inwardly-projecting boss; and an inward offset forming a relatively shorter underlapping member; an expanding-spring system interposed between said boss and the opposed end of the said inward offset forming said underlapping member; a locking bar provided upon its radially outward face with a recess for receiving said boss and said inward offset; a system of liners appropriately introduced into said recess for limiting to a prescribed extent the circumferentially-expanding influence of said spring system upon the members of said joint. Five claims.

704,000. LIFE PRESERVER. GEORGE B. CONLEY, CLEVELAND, O.

CLAIM.—1. A life preserver comprising the combination of a folding framework consisting of a series of curved ribs hinged together at their respective ends, means for engaging two of the said ribs, a flexible waterproof cover secured at one end to one of the said engaging ribs and at its other end to the other of the said engaging ribs, and arranged to completely envelop the said framework. Six claims.

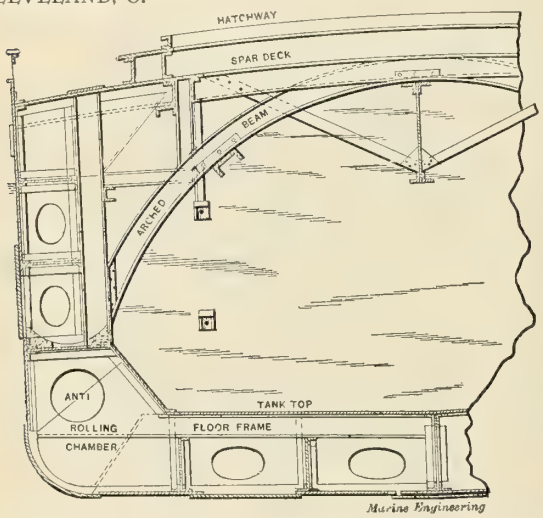
704,155. MOORING SHIPS. WILLIAM M. WALTERS, LIVERPOOL, ENGLAND.

CLAIM.—1. In combination with a ship an upwardly and backwardly sloping tube extending from the bottom of the ship near the keel, at about one-quarter of the length of the ship from the bow, to the deck; a wheel located within the tube at about the center of resistance to wind and waves, such wheel being arranged to guide the cable and means for hauling and securing the cable. Three claims.

704,186. BOAT PROPELLING DEVICE. FRANK J. GLEASON, VAN WERT, O.

CLAIM.—2. A reverse-action rowing mechanism comprising in combination with an angle lever adapted for attachment to the side of a boat, a feathering blade having integral arms which are pivoted on opposite sides of the free end of said lever, the lower end of the latter adapted to form a stop against which the face of the blade is adapted to contact during the stroke of the oar, the pivotal handle, and link connections between the same and said lever, as set forth. Two claims.

704,362. BULK-CARGO VESSEL. JOSEPH R. OLDHAM, CLEVELAND, O.



CLAIM.—1. In a vessel, the combination of arched girders spanning the hold of the vessel, transverse deck girders headed on the sides of the vessel and supported centrally by said arched girders.

2. In a hull, the combination with transverse deck girders, transversely-extending arched girders spanning the hold and supporting said deck girders, longitudinal girders connected to said transverse girders and designed to form a hatch deck, and transverse bulkheads supporting said longitudinal girders.

3. In a vessel, the combination, with a deck, of deck girders extending transversely the hold of the vessel and supporting said deck, and circular arched girders spanning the hold and supporting said deck girders.

4. In a bulk-cargo vessel, the combination, with a hull divided by transverse bulkheads, of longitudinally-extending arched girders supporting said deck and footed on said bulkheads. Four claims.

704,685. SAILING BOAT. THOMAS JENSEN, ARENDAL, NORWAY.

Three claims.

704,729. DEVICE FOR RETARDING THE SPEED OF VESSELS. AARON ZERBE, PHILADELPHIA, PA.

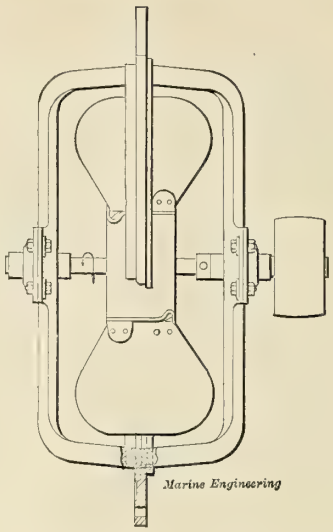
CLAIM.—1. In a device of the character described, two shafts upon each side of the boat, extending longitudinally of the boat and protruding from the rear thereof, two plates secured to the outer end of the shafts, said plates normally lying against the rear portion of the boat so as to present no resistance to the water, means located in the interior of the vessel for rotating the shafts so as to turn the plates outward beyond the sides of the vessel. Two claims.

704,905. APPARATUS FOR REPAIRING VESSELS AT SEA. NEIL J. McLAUGHLIN, BOSTON, MASS.

CLAIM.—2. A device comprising a plate provided with a pad, a rope or cable passing through said plate and pad, a locking bar attached to one end of said rope or cable, and a winding mechanism arranged upon the metallic plate for the purpose of winding the said rope or cable. Four claims.

705,046. ROTARY PROPELLER FAN AND PROPELLER FOR SHIPS. SAMUEL C. DAVIDSON, BELFAST, IRELAND.

CLAIM.—1. A rotary propeller fan or screw propeller of the disclosed type, in which the intake and discharge edge portions of each blade are formed as oppositely-dished surfaces, from approximately the central part of the peripheral edge of the blade around the margin thereof toward the hub or axle, in such manner that the advancing surface of the blade is, at the intake edge portion, substantially concave, and at the discharge edge portion substantially convex. Seven claims.



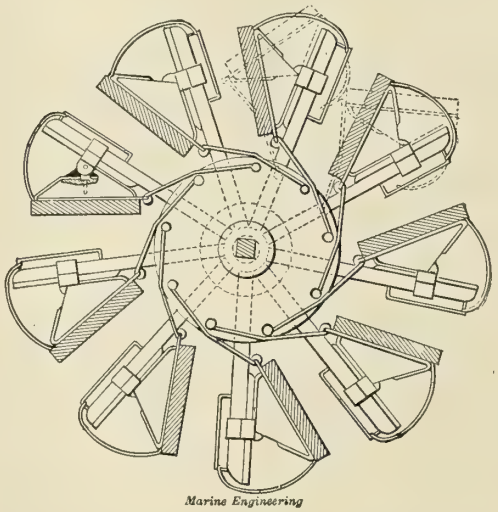
705,050. COMPASS LIGHT. OSCAR E. EATON, BOSTON, AND FRANK C. BURRILL, HULL, MASS.

Two claims.

705,188. ANTICAPSIZING DEVICE FOR BOATS. FREDERICK W. ZIMER, LONDON, ENGLAND.

CLAIM.—1. A boat provided with float supports hinged to the sides of same, a float carried by each of said supports, and a connecting rod joining the float support on one side of the boat with the corresponding support on opposite side of boat. Five claims.

705,397. PADDLE WHEEL. JOHN J. GRAHAM, IMPERIAL, PA.



CLAIM.—1. The combination, in a paddle wheel, of the shaft, the arms provided at their outer ends with the bearing plates, the adjusting wheels arranged to turn freely on the shaft, the paddle blades, the triangular rocking blocks secured at their bases to the paddle blades and provided in their apices with sockets or mortises, bands passed around said blocks and lying in the base of the said sockets and extending beyond the inner ends of the blocks, the links connecting such extensions of the bands with the adjusting wheels, the clips passed beneath the bands at the base of the sockets in the rocking blocks and provided with perforated ears, and the clasps embracing the arms and bearing plates and having lugs pivotally connected with the lugs of the clips. Five claims.

705,417. GOVERNOR FOR PROPELLER SHAFTS. WILLIAM R. MAY, NEWTON, MASS.

CLAIM.—6. The combination, with a propeller shaft, of a friction clutch comprising a fixed outer member and an inner member which is movable with the shaft, a governor shaft adjacent to the propeller shaft, a movable yoke or frame supporting the governor shaft, gearing connecting the governor shaft with the propeller shaft, said gearing including two friction members, one mounted on the propeller shaft and the other on the movable frame, said members being separable by a movement of the frame, means for moving the frame, centrifugal governor arms pivoted to the governor shaft, and connections between said arms and the inner clutch member. Six claims.